BRISTOL

OPERATION AND SERVICE

DEL 560, 570, ETC., WIDE STRIP DYNAMAST

INSTRUCTIONS

560 - 570

INSTALLATION
OPERATION
& SERVICE

THE BRISTOL COMPANY WATERBURY, CONN. 06720

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PLACE THESE INSTRUCTIONS WITH THE MAN IN CHARGE OF YOUR INSTRUMENTS

I M P O R T A N T

- Read these instructions NOW before installing instrument.
- Keep these instructions permanently & accessibly filed for future reference.
- Be sure to specify MODEL & SERIAL numbers when ordering parts, instructions, diagrams or data.
- Ship instruments or parts for repair or exchange only to Bristol's main or branch factories—not to Sales Offices.
- Be sure to—
  1. Identify your shipments with your exact return address & order number.
  2. Write nearest Bristol Factory or office giving your order number, directions & address for return shipment, full instructions for repair, etc.
- Report damage to shipments at once to shipping company. The customer assumes responsibility for collecting any claim for damages from the shipping company, on all shipments made on a collect basis.

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Completely trained and fully equipped, Bristol Service Engineers will serve you at far less than the cost of maintaining your own staff of instrument specialists.
Experts in their jobs, these engineers provide you with instrument maintenance and repair service. Yet the training and administrative expenses normally associated with these functions are eliminated. To learn more of how these factory trained engineers can save you time, money and trouble contact your nearest Bristol Branch Office or The Bristol Company, Waterbury, Connecticut 06720.

Instructions P12050-B
Issue of Nov. 1965

INSTRUCTION NO. P12050-B

OPERATION AND SERVICE

BRISTOL MODEL 560, 570, ETC., WIDE STRIP DYNAMASTER® RECORDER

FOR PEN SPEEDS OF 1, 3, 4.5, 12 & 24 SECONDS.

(USING SERIES L AMPLIFIER)

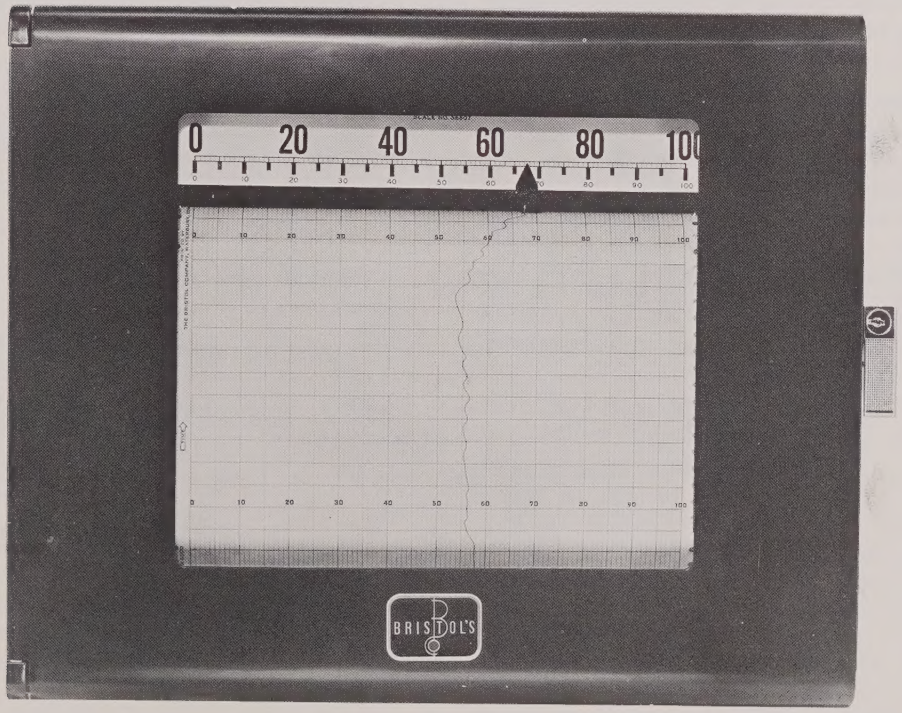

FIGURE 1. FRONT VIEW OF DYNAMASTER RECORDER

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TABLE OF CONTENTS

Page

PART I GENERAL 3

A. Description 3
B. Principle of Operation 3
1. The Dynamaster Potentiometer 3
2. The Dynamaster D-C Bridge 3
3. The Dynamaster A-C Bridge 6

PART II OPERATION

A. Starting the Dynamaster 6
B. Stopping the Dynamaster 6
C. Zener Diode Reference Voltage Source 6
D. Amplifier Gain Adjustment 6
1. On Single- and two-Pen Recorders 6
2. On Multiple-point Recorders 7

PART III SERVICE

A. Suggested Service Equipment 7
1. Stock of Replacement Parts 7
2. Test Equipment 7
B. Systematic Trouble-shooting Procedure 8
1. Power-supply Check 8
2. Balancing Motor Check 8
3. Checking Amplifiers 8
4. Measuring System on Potentiometers 8
5. Measuring System on D-C Bridges 9
6. Measuring System on A-C Bridges 9
7. The Recording System 9
C. Miscellaneous Trouble-shooting Tips 10
D. Checking Calibration 10
1. On Potentiometers 10
2. On Bridge-type Instruments 10
E. Repairs, Correspondence and Shipping 11

LIST OF ILLUSTRATIONS

Figure 1. Front View of Dynamaster Recorder 1
Figure 2. Front of Panel, Multiple-point Dynamaster Recorder 4
Figure 3. Back of Panel, Multiple-point Dynamaster Potentiometer . 4
Figure 4. Back of Panel, Single-point Dynamaster Potentiometer ... 5
Figure 5. Interior of Case 5

PART I GENERAL

NOTE: This instruction covers the basic balancing and amplifying systems in the Bristol Series 560, 570, etc., Wide-strip Dynamaster Recorders. See separate instructions covering case installation, recording systems, measuring elements, controls, etc.

A. Description

The **Dynamaster Potentiometer** is used with any millivoltage input such as that from thermocouples, photoelectric cells, shunts, magnetos, pH amplifiers, etc.

The Dynamaster D-C Bridge is used with a very low range resistance type measuring element, such as resistance thermometer bulbs, strain gauges, etc.

The Dynamaster A-C Bridge is used with any resistance type of measuring element, such as resistance thermometer bulbs, conductivity cell, etc. The a-c bridge should not be used where a-c pickup is a problem.

Both single- and two-pen recorders are available as well as multiple-point recorders capable of recording up to 24 variables.

The major components of the instruments are :

1. The potentiometer or bridge circuit
2. The Syncroverter® switch
3. The input transformer
4. The amplifier
5. The balancing motor
6. The recording system
7. The multiple-point switching system (used only in the multiple-point recorders)

B. Principle of Operation

1. The Dynamaster Potentiometer. A potentiometer measures an emf of unknown value by comparing it with a known emf. In the Dynamaster potentiometer, the millivoltage input from the sensing element is connected in series with the potentiometer circuit and Syncroverter switch. A standard voltage, supplied by a Zener diode reference voltage source in the potentiometer circuit, is automatically adjusted to balance any change in the millivoltage input. Any change in the measuring-element voltage creates a d-c voltage unbalance in the potentiometer circuit. This d-c voltage unbalance is converted to an a-c voltage unbalance by the Syncroverter switch. The Syncroverter a-c unbalance output voltage is then increased by the amplifier to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slidewire to restore electrical balance in the potentiometer circuit and simultaneously moves the pen and pointer to record and indicate, on the chart or scale, the value of the variable being measured.

The balancing action starts with the slightest change in the output voltage of the sensing element. Thus, recording and indicating of the measured quantity are practically instantaneous.

When balance has been restored, the entire potentiometer remains at rest until another change in the measured variable occurs.

2. The Dynamaster D-C Bridge. In a D-C bridge, the measuring element forms one leg of the d-c bridge. A d-c power pack supplies 7 to 9 volts d-c to the bridge circuit. When the resistance of of the measuring element changes, current flows in the bridge and a d-c voltage unbalance is created in the bridge circuit. This d-c voltage unbalance is converted to an a-c voltage unbalance by the Syncroverter switch. The Syncroverter a-c unbalance output voltage is then increased by the amplifier to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slidewire to restore electrical balance in the bridge circuit and simultaneously moves the pen and pointer to record and indicate, on the chart or scale, the value of the variable being measured.

This balancing action starts with the slightest change in the resistance of the

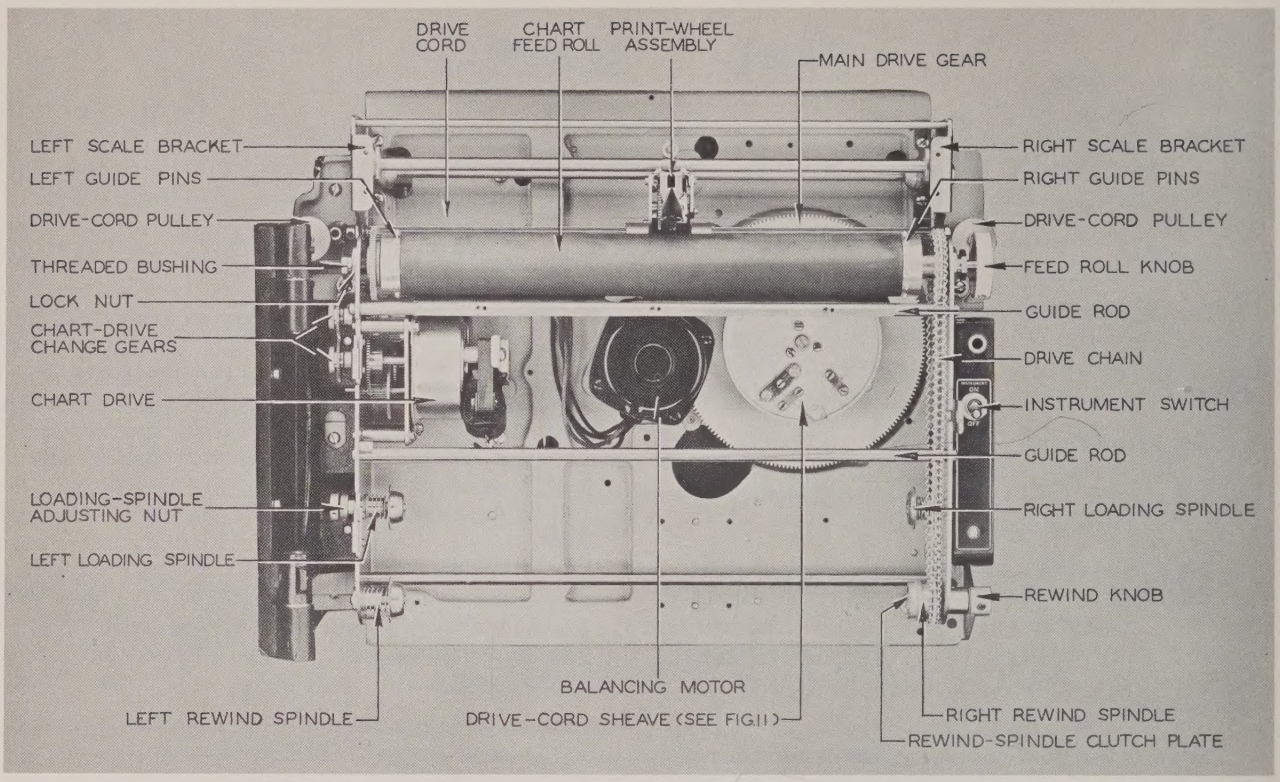

FIGURE 2. FRONT OF PANEL, MULTIPLE-POINT DYNAMASTER RECORDER

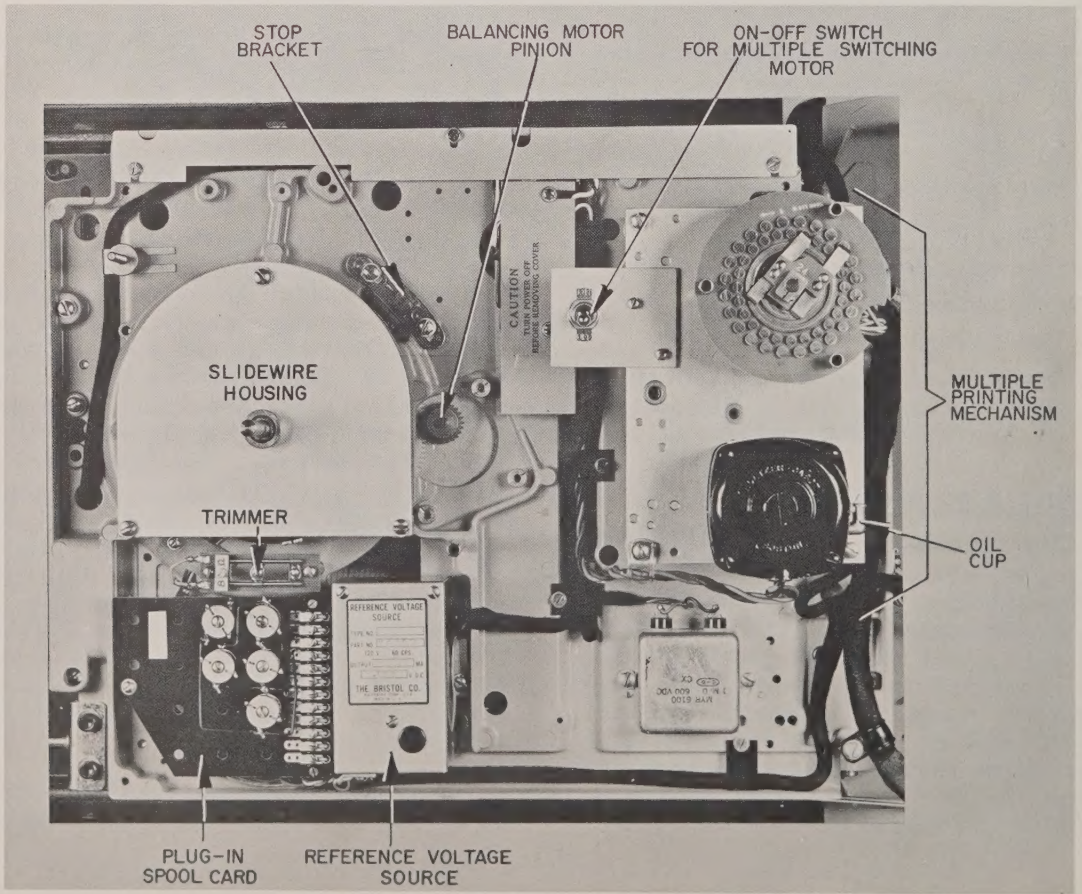

FIGURE 3. BACK OF PANEL, MULTIPLE-POINT DYNAMASTER POTENTIOMETER

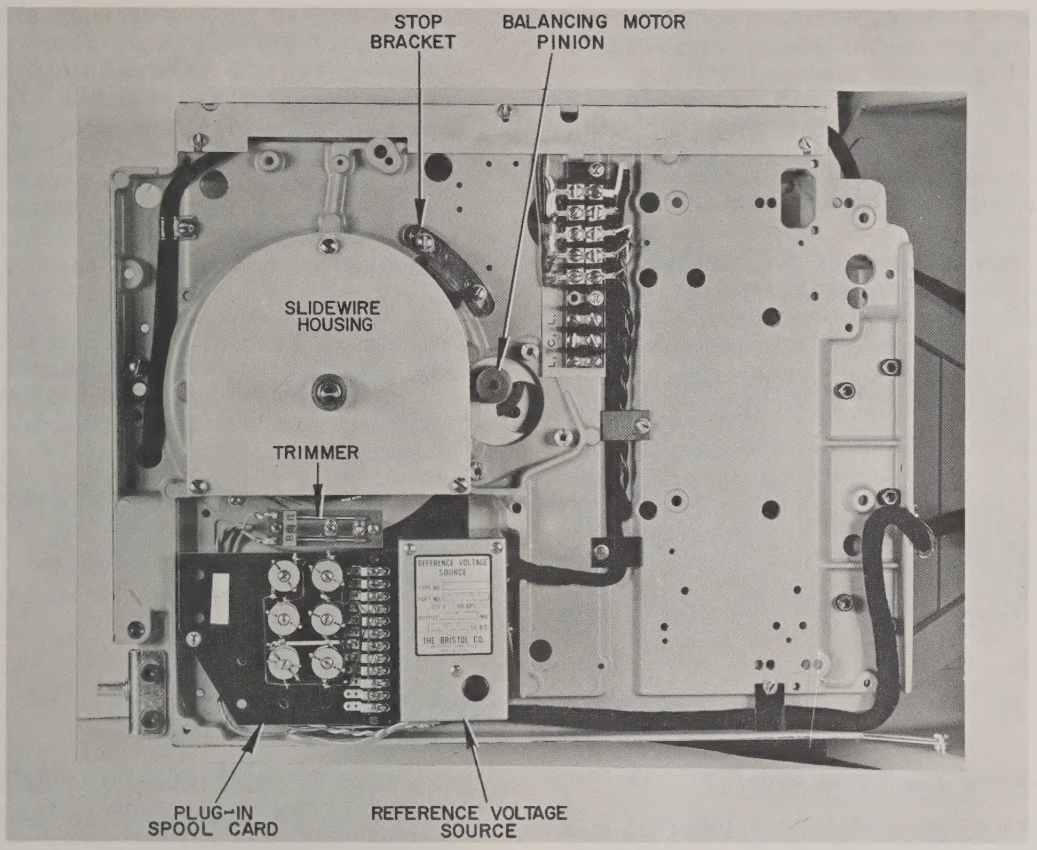

FIGURE 4. BACK OF PANEL, SINGLE-POINT DYNAMASTER POTENTIOMETER

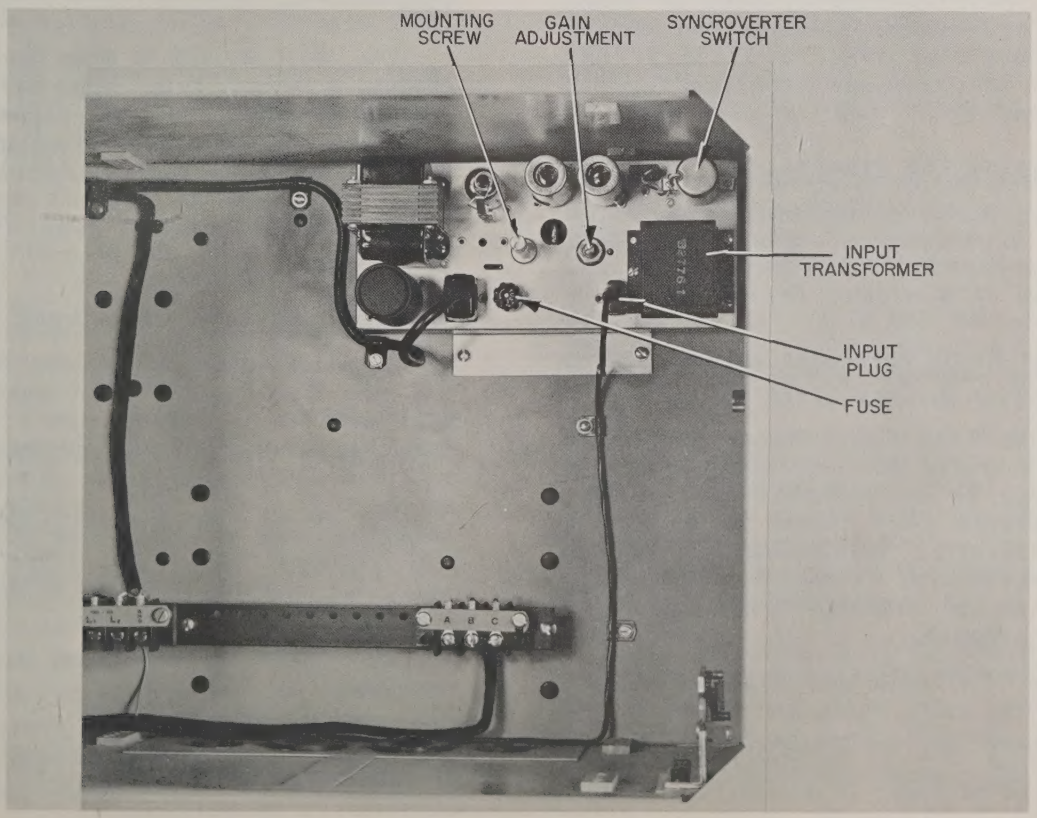

FIGURE 5. INTERIOR OF CASE

measuring element. Thus, recording and indicating of the measured variable is practically instantaneous.

When balance has been restored, the entire bridge remains at rest until another change in the measured variable occurs.

3. The Dynamaster A-C Bridge. The a-c bridge is the same as the d-c bridge except for two items. In the a-c bridge, a bridge transformer is used instead of a d-c power pack and a shorting plug is used in place of the Syncroverter switch.

In an a-c bridge, the measuring element forms one leg of the a-c bridge. A bridge transformer supplies a-c to the bridge circuit. When the resistance of the measuring element changes, current flows in the bridge and a voltage unbalance (error signal) is created. This error signal is fed into the amplifier and amplified to a power level sufficient to operate the balancing motor. The balancing motor adjusts the sliding contact on the slidewire to restore electrical balance in the bridge circuit and simultaneously moves the pen and pointer to record and indicate on the chart or scale, the value of the variable being measured.

This balancing action starts immediately with the slightest change in the resistance of the measuring element. Thus, recording and indicating of the measured quantity are practically instantaneous.

When balance has been restored, the entire bridge remains at rest until another change in the measured variable occurs.

PART II OPERATION

A. Starting the Dynamaster

To start the Dynamaster after it has been completely and correctly wired, simply turn on the instrument on-off switch. Nothing further need be done. If your Dynamaster is equipped with a control unit or other accessory, see separate instructions provided for its operation.

B. Stopping the Dynamaster

To stop the Dynamaster, merely turn off the instrument on-off switch. For a prolonged shut-down, the instrument should be stored in a clean, dry place.

C. Zener Diode Reference Voltage Source (used on Potentiometers only).

The Bristol Zener Diode Reference Voltage Source, used on all d-c potentiometers, is an accurate d-c voltage source with a high degree of stability and reliability. It utilizes Zener diodes as the reference elements in the preregulating and output stages of the regulating circuit.

This unit is factory adjusted to produce 1.0190 ±.001 volts across the bridge circuit. No additional adjustment should be required. If it is desired to check the output voltage, it should be done with the load of the bridge circuit disconnected at the reference voltage source output terminal block, and a load of 339.67 ohms substituted across the terminals as equivalent to the proper bridge load.

The check should be made by balancing against a potentiometric test set. If the voltage is not within tolerance, remove the black snap-in plug in the cover below the name plate and adjust the potentiometer to produce the correct output voltage. Replace snap-in plug after any adjustment.

D. Amplifier Gain Adjustment

1. On Single- and Two-pen Recorders. The only time the amplifier gain adjustment need be checked is after changing tubes or doing other service work on the amplifier, and about once every 3 to 6 months thereafter. The reason for the periodic check is because the vacuum tubes age with use. While this check is being made, the measured variable should be at a steady value.

To check amplifier gain, proceed as follows:

Allow amplifier to warm up for at least 2 minutes. Turn the balancing-motor pinion (drive gear) manually to the right

and release it. Then turn pinion to the left and release it. The pen should return quickly to its original position each time. If it does not return to its original position completely and quickly, it indicates that the amplifier gain (or sensitivity) is too low. To increase the gain, turn gain adjusting screw in a clockwise direction. When the gain adjustment has reached its maximum clockwise direction, the amplifier lacks sensitivity and requires new tubes.

There is an optimum position for the gain control. If the gain is too low, the pen will not return quickly to its proper value when the balancing motor is manually shifted off balance. If the gain is too high, the pen may "hunt" (mechanical oscillation of the pen). On some instruments if an abnormal pickup in the external measuring circuit is present, it is possible to turn the gain high enough to overload the amplifier and cause the balancing motor to act sluggishly. This condition can be corrected by reducing the gain (turning gain adjustment counterclockwise).

2. On Multiple-point Recorders. The gain adjustment on multiple-point recorders is made in the same manner as on single-pen recorders except that the motor on the multiple-switching mechanism must be stopped during this adjustment.

Present instruments are provided with a switch, mounted on the switching mechanism, to cut the power to switching motor.

On instruments without a switch, the power may be broken by disconnecting the gray lead from the switching motor. Be sure to turn off the instrument power supply before disconnecting this lead.

PART III SERVICE

A. Suggested Service Equipment.

1. Stock of Replacement Parts. It is suggested that the following replacement parts be kept in stock. The vacuum tubes listed below are standard types and are available at any radio supply store:

TYPE 6EU7 voltage amplifier tube
TYPE 6BQ5 power amplifier tube
Plug-in-type Electrolytic Filter Capacitor with octal base (10-10-10 mfd. 450 volt)

Note: Electrolytic capacitors deteriorate in storage. Their shelf life should not be over 18 months. Replacement electrolytic capacitors can be kept in usable condition indefinitely by placing them in service in the Dynamaster for an hour or two every six months.

FUSES for amplifier (1/8 ampere Little-fuse Slo-blo).

AMPLIFIER. Where several Dynamasters are in use or where continuous instrument performance is of critical importance, it is recommended that spare replacement amplifiers be kept in stock.

PEN for single-pen recorders

PENS for two-pen recorders

Inked felts for multiple-point recorders

2. Test Equipment

A signal generator, such as Bristol's Dynamaster Part No. C1038, is highly recommended because it provides a quick means for isolating trouble in the detection circuit of the Dynamaster without having to remove the Dynamaster from service or disconnecting the input circuit or the power to the instrument.

The Bristol Dynaprobe test unit is a compact signal generator designed for use with the Bristol Dynamaster.

The Dynaprobe consists of a covered metal box with a 2-foot cable with **test probes** or a test plug and two additional extensions, one with lugs at the end and the other with a female plug. The box has a toggle switch to provide either a 10 millivolt d-c signal or a 30 millivolt a-c signal as required. The output signal is neither regulated or calibrated. The back of the box is fitted with two prongs and two spring type connections to permit plugging the unit into the power terminal block of the Dynamaster.

The Dynaprobe is also equipped with a receptacle to provide 120 volt a.c. for a soldering iron.

An a-c voltmeter or test lamp is required to perform the power-supply check.

An **ohmmeter** is convenient when checking the continuity of the measuring system.

On potentiometer-type instruments, a **potentiometric test set** is required (one with ranges 0 to 150 millivolts and 1.019 volts).

On bridge-type instruments, a set of **test resistance spools** is handy for checking resistance measuring instruments. The Bristol Company manufactures very accurate test resistance spools. Spools may be ordered by the set or singly for any value to fit calibration of instrument. Ordinary variations in room temperature do not affect their accuracy. When ordering spools, specify serial number, curve and check point desired.

B. Systematic Trouble-shooting Procedure

Should the Dynamaster fail in any way, it is first necessary to determine which part is faulty. The following systematic procedure is suggested in order that repairs may be accomplished with a minimum of lost time and expense.

1. Power-supply Check. Using a 150-volt range a-c voltmeter (or test lamp), check for line voltage across instrument power terminals L1 and L2 on back of case, and L1 and L2 terminals on back of hinged panel.

2. Balancing Motor Check

Caution: Always be sure to turn power switch off before shifting the two control winding wires because of the high voltage across terminals M1 and M2.

Turn off instrument power switch. Remove the red and blue control-winding wires from terminals M1 and M2, on rear of hinged panel, and connect them across terminals L1 and L2. Remove black motor lead from L1 and wire a 1-microfarad capacitor in series with it and reconnect to L1. Turn on power switch. The motor should move the pen up or downscale (depending upon phase). Next, turn off power switch and reverse these wires from the control winding. The balancing motor should move the pen in the opposite direction. If the balancing motor fails to move the pen up or downscale with the above test, it could mean that one of the following conditions exist.

1. No power to balancing motor
2. Balancing motor defective
3. Mechanical failure between balancing motor pinion, drive gear and recording pen.

Note: When test has been completed, be sure to return red and blue wires to their original positions (see power circuit wiring diagram) and remove capacitor in series with black wire.

3. Checking Amplifiers

a. With Syncroverter Switch (used on d-c instruments)

With the external power supply switch off, plug Dynaprobe into power supply terminal block on back of instrument case. Set Dynaprobe toggle switch in d-c position. Using extension with polarized female plug, plug extension into input terminals of amplifier. Turn on external power switch. If amplifier is working properly, the balancing motor will move the pen up or downscale (depending upon phase). Reversing the cable plugs on the Dynaprobe will cause the balancing motor to move the pen in the opposite direction.

If the balancing motor does not move the pen up or downscale, disconnect the exitation leads (yellow and brown wires) from the Syncroverter Switch and apply a-c from Dynaprobe to input terminals of amplifier. If instrument works replace Syncroverter Switch.

If instrument does not work after any of the above checks, check fuse in amplifier, replace tubes and filter capacitor in amplifier. If this does not work, replace the amplifier.

b. With plug. (used on a-c bridges).

Checking amplifiers used on a-c bridges is the same as paragraph "a" above except that the Dynaprobe toggle switch should be in the a-c position in all cases and the reference to Syncroverter should be ignored.

4. Measuring System on Potentiometers

The potentiometer type of Dynamaster uses the null-balance potentiometer circuit. The measuring element (such as a thermocouple, magneto, etc.) is wired in series with the potentiometer circuit, Syncroverter contacts and primary winding of the input transformer. This means that

an open circuit anywhere in the measuring circuit, slidewire, Syncroverter contacts or primary winding of the input transformer will produce the same result: no error signal in the circuit and consequently no output from the amplifier to the balancing motor.

Check carefully the particular measuring element used to see that it is functioning correctly. Check particularly the wiring connections at both the measuring element and the instrument. Disconnect the measuring element leads from the instrument and connect them to a potentiometric test set to be sure that the measuring element is producing the voltage required for the existing conditions. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Caution: Never put an ohmmeter across any part of the measuring system without first disconnecting the input leads to the amplifier. The reason for this is that the ohmmeter produces a relatively high current and would damage the Syncroverter contacts.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

Check to see that the slidewire brush arm makes good contact with the slidewire (contact pressure is 35-45 grams). Try cleaning slidewire with Bristol cleaning fluid. Allow to dry. Then apply a small amount of Cramolin to slidewire and wipe off excess with a clean lint free cloth.

Caution: If any solvent other than Bristol's cleaning fluid is used to clean slidewire, it must be a type that will not leave a residue or one that attacks varnish.

If the above checks have been performed and the instrument still fails to function, the possible fault may be either an open circuit or a short circuit somewhere in the measuring system. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

5. Measuring System on D-C Bridges. On a d-c bridge, the measuring element is wired so as to form one leg of the bridge. An open circuit anywhere in the bridge will produce an infinite resistance, driving the pen to the top or bottom of the chart depending upon what portion of the bridge is open circuited. If an open circuit is suspected, it can easily be checked with an ohmmeter. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Caution: Never put an ohmmeter across any part of the measuring system without first disconnecting the input leads to the amplifier. The reason for this is that the ohmmeter produces a relatively high current and would damage the Syncroverter contacts.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

a. Check output voltage of bridge voltage source (7 to 9 volts d.c.).

b. Check to see that the slidewire brush arm makes good contact with the slidewire (contact pressure is 35-45 grams). Try cleaning slidewire with Bristol's cleaning fluid. Allow to dry. Then apply a small amount of Cramolin to slidewire and wipe off excess with a clean lint free cloth.

c. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

6. Measuring System on A-C Bridge. On an a-c bridge, the measuring element is wired so as to form one leg of the bridge. An open circuit anywhere in the bridge will produce an infinite resistance, driving the pen to the top or bottom of the chart depending upon what portion of the bridge is open circuited. If an open circuit is suspected, it can easily be checked with an ohmmeter. See separate instructions covering servicing and checking procedures for the particular measuring element used.

Assuming that the measuring element and its leads have been eliminated as the source of trouble, proceed as follows:

a. Check for voltage on secondary winding of bridge transformer (7 to 9 volts).

b. Check to see that the slidewire brush arm makes good contact with the slidewire (contact pressure is 35-45 grams). Try cleaning slidewire with Bristol cleaning fluid. Allow to dry. Then apply a small amount of Cramolin to

slidewire and wipe off excess with a clean lint free cloth.

Caution: If any solvent other than Bristol's cleaning fluid is used to clean slidewire, it must be a type that will not leave a residue or one that attacks varnish.

If all of the above checks have been performed and the instrument still fails to function, the possible fault may be either an open circuit or a short circuit somewhere in the measuring system. Look for loose or poor connections or possibly a dab of solder that might short out two connections.

7. The Recording System. The recording system is mechanical. It includes the chart drive and its gear train, chart feed roll, pen or print wheel drive cord and pulleys, etc.

Check the recording system for mechanical troubles, such as loose or binding gears, pulleys and fittings, etc. Move the pen or print wheel up or downscale manually by turning the main drive gear (with power off). It should move freely from one end of the scale to the other.

Feed the chart manually by turning the feed-roll knob counterclockwise. The tension of the feed-roll clutch should be felt, but the chart should feed straight and smooth without tearing or distorting the holes. The pen or print wheel should make a clean, legible record.

See separate instructions on the servicing of the recorder system.

C. Miscellaneous Trouble-shooting Tips

In general, the following symptoms of troubles described below are caused by definite faults.

For all failures not specifically described below, follow the systematic trouble-shooting procedure outlined in Paragraph B, part III.

1. Symptoms: Pen or print wheel remains stationary regardless of changes in the value of the measured variable.

Possible faults:

a. Defective line fuses

b. Power failure

c. Defective amplifier fuse. An amplifier fuse which burns out repeatedly generally indicates a bad rectifier tube or filter capacitor (plug-in capacitor).

d. Defective tube in amplifier

e. Defective filter capacitor

f. Open circuit in measuring element

g. Syncroverter-switch failure

h. Defective balancing motor

2. Symptoms: Pen or print wheel records incorrect values.

Possible faults:

a. Defective measuring element

b. Incorrect gain adjustment

3. Symptoms: Chart does not feed properly.

Possible faults:

a. Chart is not lined up properly

b. Feed-roll clutch is slipping

4. Symptoms: Chart speed is incorrect.

Possible faults:

a. Wrong change gears

b. Defective chart drive motor

c. Frequency of power supply incorrect

D. Checking Calibration

1. On Potentiometers. To check the the calibration of a potentiometer requires the use of a potentiometric test set (one with ranges 0-150 millivolts and 0-to 1.5 volts).

a. Connect potentiometer to input terminals of instrument and turn on instrument power supply. Allow a 10 minute warm up before proceeding with the next step.

b. Set test set for 10% of scale range. Check sensitivity of recorder by moving pen up-scale (by manually turning balancing motor pinion) and allowing instrument to rebalance. Then move pen down-scale and allow instrument to rebalance. Note the dead band. It should be between 0.1 and .05% of full scale. If dead band is greater than 0.1% turn gain control on amplifier clockwise until dead band is correct. If dead band is less than .05%, turn gain control counterclockwise until dead band is correct.

Adjust pen and pointer to read correctly at this point. Do this by loosen-

ing the two screws on the top of the pen carriage which clamps the drive cord to the pen carriage. When pen is correct, tighten screws in clamp.

c. Next, set test set at 80% of scale range. If pen or pointer reads low, loosen slider on trimmer and move slider to left until pen is correct. Tighten slider and check calibration at several more points on scale. If pen or pointer reads high, move slider on trimmer to the right.

2. On Bridge-type Instruments. A bridge-type instrument may be checked with precision test resistors. These precision resistors permit a rapid calibration check at one or more points on the instrument scale. Two resistors are usually sufficient; one representing 10% of the scale range and the other representing 80% of the scale range. To make the check, disconnect the primary element at the terminal block and connect the checking resistor, representing the 10% scale value, in its place. The instrument should read the 10% scale value. If instrument does not record proper value, adjust pen to read correctly. Pen may be adjusted by loosening the two screws on the top of the pen carriage which clamps the drive cord to the pen carriage. When pen reads the correct value, retighten screws in clamp.

Next, connect the resistor, representing the 80% scale value, to the instrument. Instrument should read the 80% scale value. If pen reads low, loosen slider on trimmer and move slider to the left until pen reads correctly. Retighten slider. If pen reads high, move slider on trimmer to the right.

The Bristol Company manufactures very accurate test resistance spools. Spools may be ordered for any value to fit calibration of instrument. When ordering spools, complete with leads and clips, specify from sheet A2833 and give desired resistance or temperature span (F or C) and designate curve and serial number of instrument.

E. Repairs, Correspondence and Shipping

If the Dynamaster cannot be repaired with the information furnished in this instruction, it should be shipped to the nearest Company Branch or Main Factory for repair or replacement. Do not ship instruments to Branch Offices. Be sure to mark your return address plainly.

In all correspondence please mention the instrument model and serial number (as listed on its nameplate) and your repair order number. Address all correspondence to the Bristol Company branch or Main Offices, a list of which is found in all instruction books.

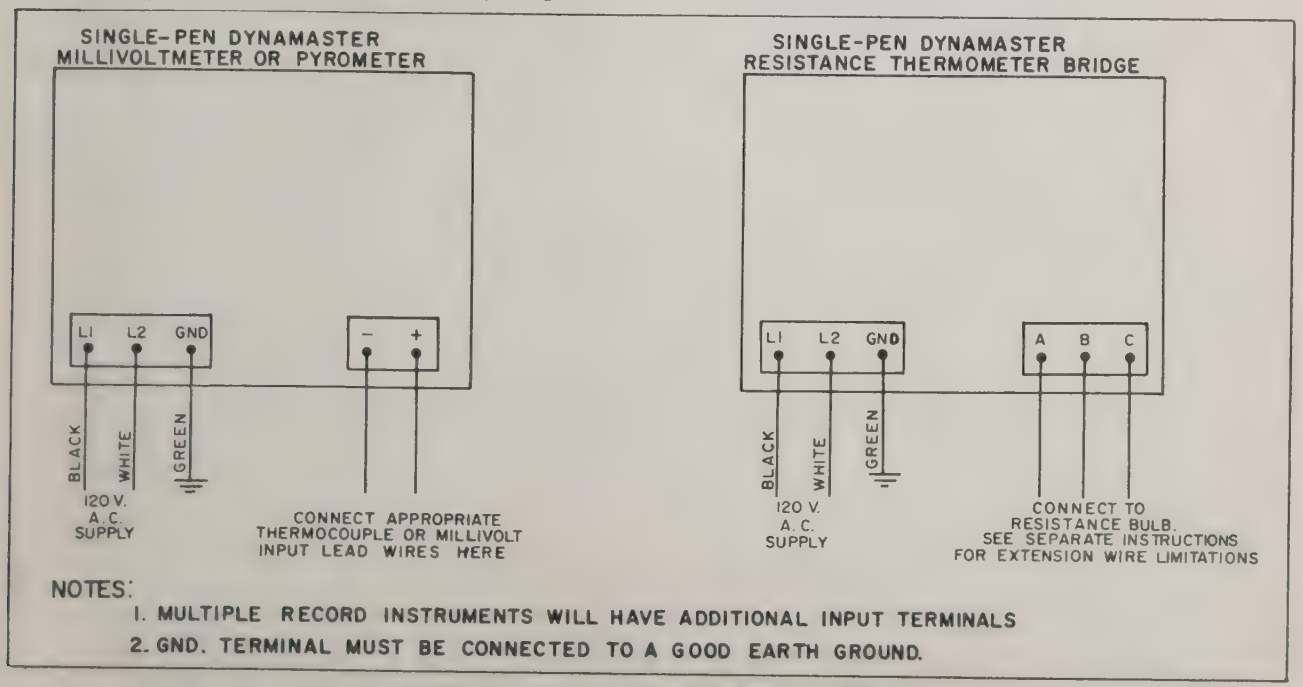

FIGURE 6. TYPICAL EXTERNAL WIRING DIAGRAM.

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INSTRUCTION NO. Y19820

INSTALLATION AND SERVICE OF BRISTOL'S® MODEL 560, 570 & 571 CASE AND WIDE-STRIP RECORDING SYSTEM

- TABLE OF CONTENTS -

		Page
PART I	INSTALLATION	2
A.	Unpacking the Instrument	2
B.	Locating and Mounting the Instrument	2
C.	External Wiring and Piping	2
D.	Installing the Chart	3
E.	Installing and Starting Fountain Pens	3
F.	Installing Ball-point Pens	3
PART II	SERVICE	4
A.	Lubrication	4
	1. Balancing Motor	4
	2. Multiple-point Recorders	4
B.	Care of the Pen in the Single-pen and Two-pen Recorders	4
C.	Care of the Print Wheel in Multiple-point Recorders	4
D.	Lining up the Chart	4
E.	Setting the Mechanical Zero	6
F.	Adjusting the Rewind-spindle Clutch	6
G.	Adjusting the Feed-roll Clutch	6
H.	Replacing or Adjusting the Pen or Print-wheel Drive Cord	7
J.	Changing Chart Speeds	7

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Note: This instruction covers the installation and service of the case and wide-strip recording system only. See separate instructions furnished covering the basic balancing, amplifying and switching systems in the Bristol Dynamaster Potentiometer, D-C Bridge or A-C Bridge-type Instruments. See also separate instructions covering measuring elements, controls, alarms, etc., as required.

PART I INSTALLATION

A. Unpacking the Instrument

Do not throw away the packing material until you have found the mounting brackets and screws as shown in the mounting-dimension drawing, and the other accessories, such as ink, charts, spare parts, etc.

B. Locating and Mounting the Instrument

The Dynamaster may be surface mounted or flush panel mounted. Although the instrument is exceptionally free from the effects of dust, dirt, vibration, corrosive fumes and extremes of temperature, it should be located as remotely as possible from such unfavorable conditions. The location should also be convenient for service and general utility.

The instrument should be reasonably level. Proper clearance should be allowed between the Dynamaster and other instruments on the wall or panel, and clearance must be given at the bottom of the case for the wiring or piping connections.

C. External Wiring and Piping

Before connecting any wiring to the Dynamaster, check the voltage and frequency listed on the nameplate of the instrument. To connect the Dynamaster to any voltage other than 120 volts, a suitable transformer must be used. All wiring connections are made on the terminal strips mounted inside on the back of the case. The terminals are readily accessible by opening the door of the Dynamaster and swinging the panel out after first depressing its latch.

The instrument is provided with four holes in the bottom of the case to accommodate standard conduit fittings. Two of the holes accomodate 1 1/4" conduit connections and the other two accommodate 3/4" conduit connections. Conduit should be used whenever possible to bring all electrical circuits into the case. If conduit is not used, the rubber grommets supplied with the instrument should be used by punching a small hole in the center of the grommet.

The wiring diagrams for your particular Dynamaster are provided separately. The measuring circuit is usually covered on one sheet and the power circuit on another sheet. If your instrument is equipped with an electric control or alarm, a third diagram will be furnished covering its wiring.

When connecting the power line to the instrument, make sure that the grounded side of the line is connected to the right-hand power terminal.

A good ground must be connected to the terminal marked GND.

Note: Do not install measuring circuits such as thermocouple wires in the same conduit with higher-voltage lines.

Piping or tubing will be required if a pneumatic control is supplied in the instrument. Air-control instruments are provided with case connections in the bottom of the case for standard 1/4" pipe or 3/8" copper tubing.

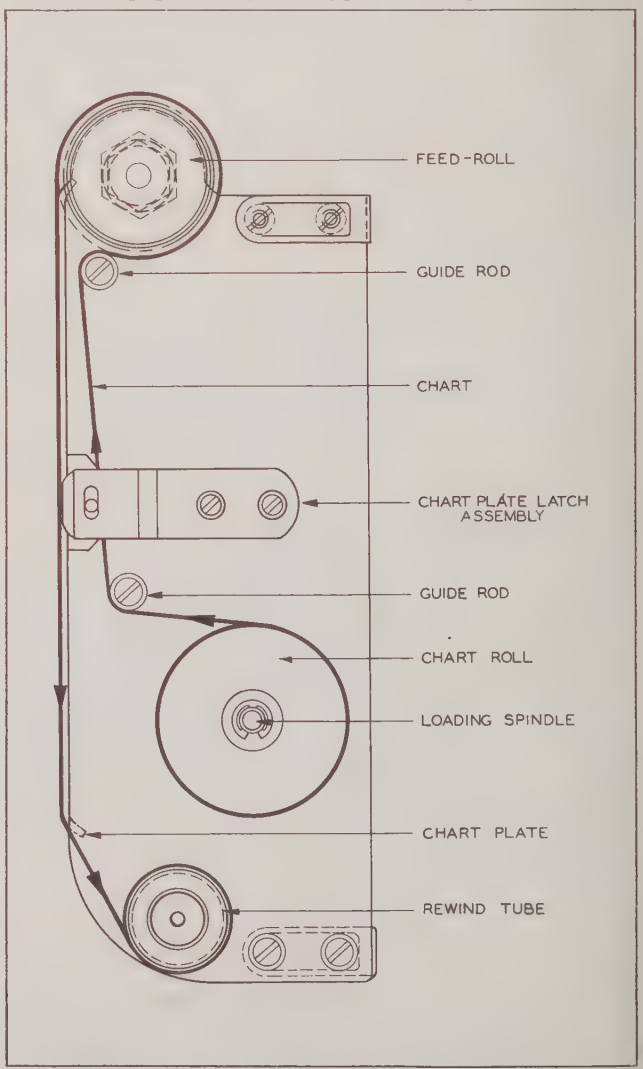


FIGURE I. CHART INSTALLATION DRAWING

D. Installing the Chart

A new chart roll must be flush with the left end of its tube. Before installing the chart, tap the left end (end with the round holes) on a flat surface to make sure that the tube and chart are flush. Release the chart-plate latch and swing out the chart plate. Fit the new chart roll onto the loading spindles (Fig. 1) with the round feed holes on the left. Thread the chart over the guide rods and under and around the feed roll (see Fig. 5). Latch the chart plate and attach the free end of the chart to the rewind tube with the clip provided. Take about 1 1/2 turns around the rewind tube and fit the tube onto the rewind spindles so that the key on the right rewind spindle fits into the slot in the tube. Tighten the chart by turning the rewind-spindle knob counterclockwise.

E. Installing and Starting Fountain Pens

Fountain pens are packed with the other accessories included with the instrument. Before installing the fountain pen or pens, the pen reservoirs must be filled with ink and the ink sucked thru the pen point by means of the pen starter provided. Then insert the pen or pens in the pen bracket, making sure that the pins on the pen go completely into the slots in the pen bracket. See Fig. 2 for installation of pens in 2-pen instruments.

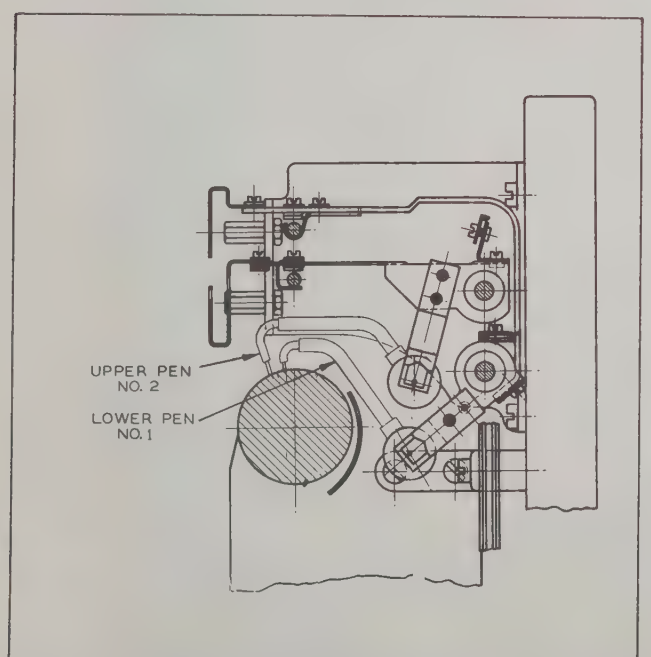


FIG. 2. INSTALLATION OF PEN ON TWO-PEN RECORDERS.

Multiple-point recorders are shipped with the print wheel and inked felts already installed.

F. Installing Ball-point Pens

Ball-point pens use a special mounting bracket as shown in figure 3.

To replace a ball-point pen, remove the cartridge end from the hole in the bracket and unscrew the pen end. Screw in the new pen and place cartridge end in bracket hole as shown in figure 3.

A ball-point pen should exert a force of approximately 15 grams on the chart paper for optimum recording results with a wide range of writing velocities. The mounting bracket design for this attachment assures the correct angle and pressure for this pen. The pen mounts perpendicular to the chart paper. The ink supply must always be above the ball-point, and the bending radius of the cartridge should not be less than 1/2 inch.

Ball-point pens are available in the following ink colors: Red, Part #A8253; Blue, A8254; Green, A8255; and Black, A8256.

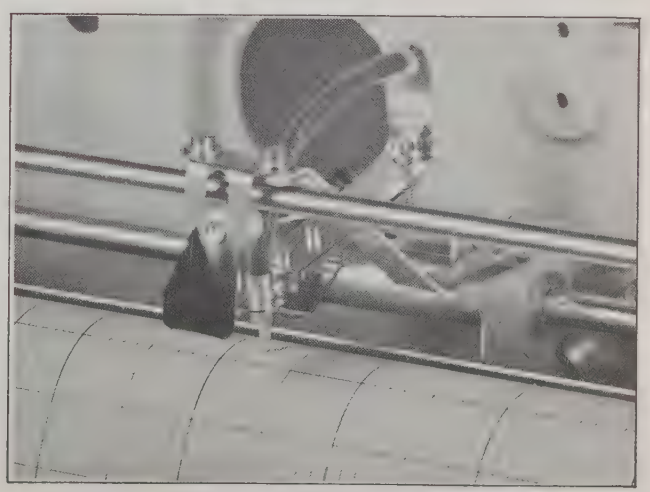


FIGURE 3. ATTACHMENT T113 BALL-POINT PEN

PART II SERVICE

A. Lubrication

1. Balancing Motor. Present motors, equipped with open gear train, have ball bearings which require no lubrication. However, the fibre gear that meshes with the motor pinion should be oiled with 2 or 3 drops of Gulf electric motor oil about once every six months. This light oiling of the fibre gear helps to prolong its life.

2. Multiple-point Recorders. The multiple-point Dynamaster requires lubrication of the print-wheel assembly and switching mechanism. There are three oil holes in the print-wheel assembly (Fig. 4). Oil these points once a year with Gulf electric motor oil.

There are three oil holes in the gear train of the switching mechanism. They should be oiled once a year.

The selector-switch contacts are normally self-cleaning. If it should be necessary to clean these contacts, they should be cleaned with a cloth and a solvent such as Bristol cleaning fluid Part A5700. After cleaning, the contacts should be lubricated with a very thin film of Cramolin. It is not necessary to remove the brush arm when cleaning the contacts. The brush arms may be rotated **counterclockwise** without damaging the unit or getting the print wheel out of step. If the brush arm is ever removed, note carefully the contacts on which the brush arm rests so that it may be returned to the same position. In addition to locating the brush arm correctly, the brush arm assembly should be pressed firmly against the hub of the switch-contact plate before tightening its setscrew. This guarantees the correct pressure on the contacts. Starting on or about June 1, 1954, the switch-contact-plate hub will have a locating pin that fits into a hole in the brush-arm assembly. In this way, if the brush arm is taken off, the brush arm can be easily and correctly returned to its synchronized position. Always push brush arm tightly against hub of contact plate before retightening its setscrew.

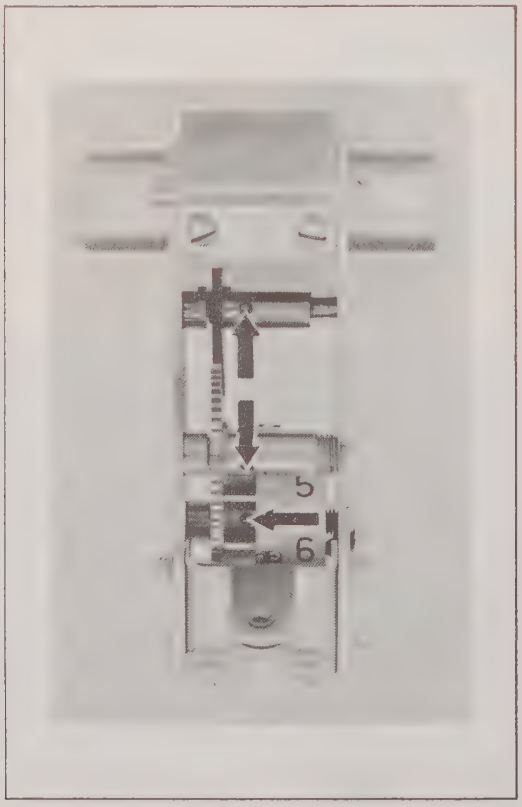


FIGURE 4. PHOTO SHOWING OIL HOLES ON PRINT WHEEL ASSEMBLY.

Holtzer-Cabot gear case motors with oil cup, used on the multiple-switching mechanism and when required on chart drives, should be oiled every **3 months** with **3 cc's** of Houghton Gearlub 890 (Bristol Part No. 91982 for 2 ounce can).

Nothing else should be oiled in the Dynamaster. All other bearings are either dry (and should be kept clean) or are permanently sealed and require no lubrication during their normal lifetime.

B. Care of the Pen in the Single-pen and Two-pen Recorders

The pen should be kept at least a quarter full of ink. If it clogs or draws a poor record, clean it with the wire pen cleaner provided. If necessary, wash the pen with soap and warm water.

C. Care of the Print Wheel in Multiple-point Recorders

When the printed record becomes too light for easy reading, the ink pads should be changed. The single-color ink pad may be replaced by removing the thumb nut and sliding off the old pad. The multi-colored pads should be replaced one at a time so that the color sequence will not get mixed up. When replacing the pad holder in the multi-colored unit, be sure to line up the pin in the holder with the hole in the gear and the hole in the indicating disk.

D. Lining up the Chart.

It is extremely important that the chart be correctly lined up. This is done very carefully at The Bristol Factory and should seldom need adjustment. However, if the left-hand guide pins on the feed roll should tear or distort the holes in the chart, the chart must be realigned as follows:

If the chart tends to tear on the left side of the holes, loosen setscrew in loading-spindle adjusting nut and turn adjusting nut in a clockwise direction until chart feeds properly. While making this adjustment, hold onto the collar located to the left of and on the same shaft

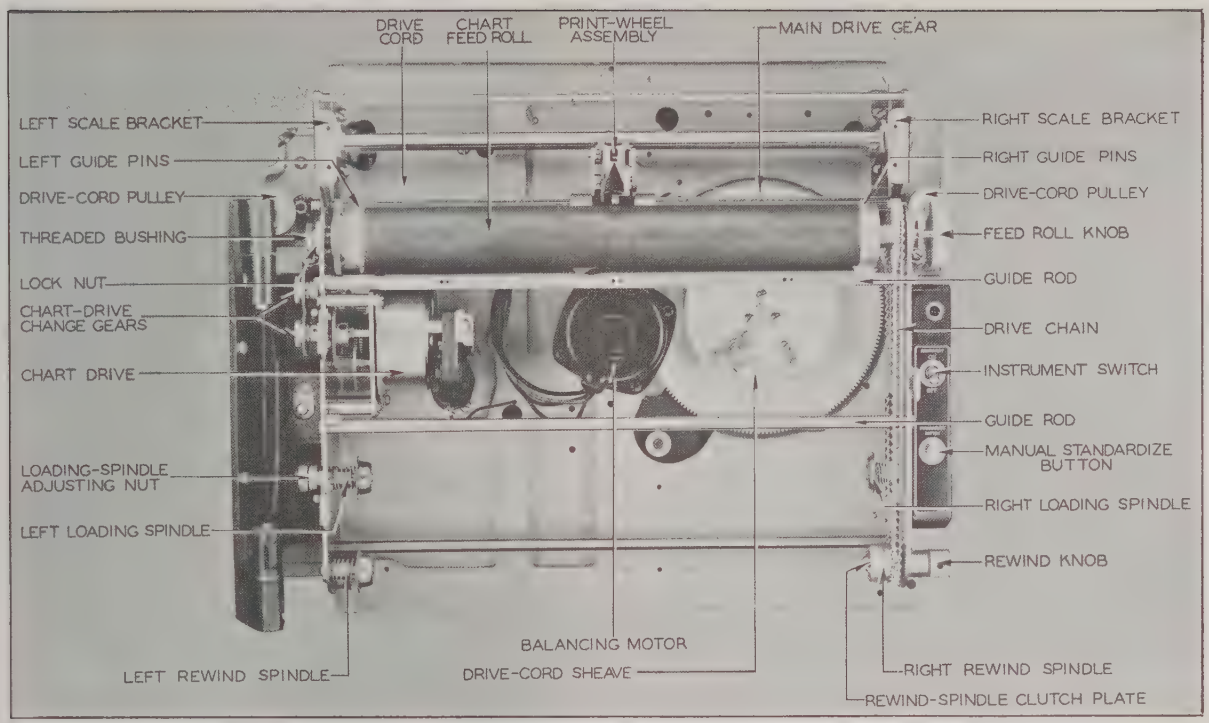


FIGURE 5. FRONT OF PANEL, MULTIPLE-POINT DYNAMASTER

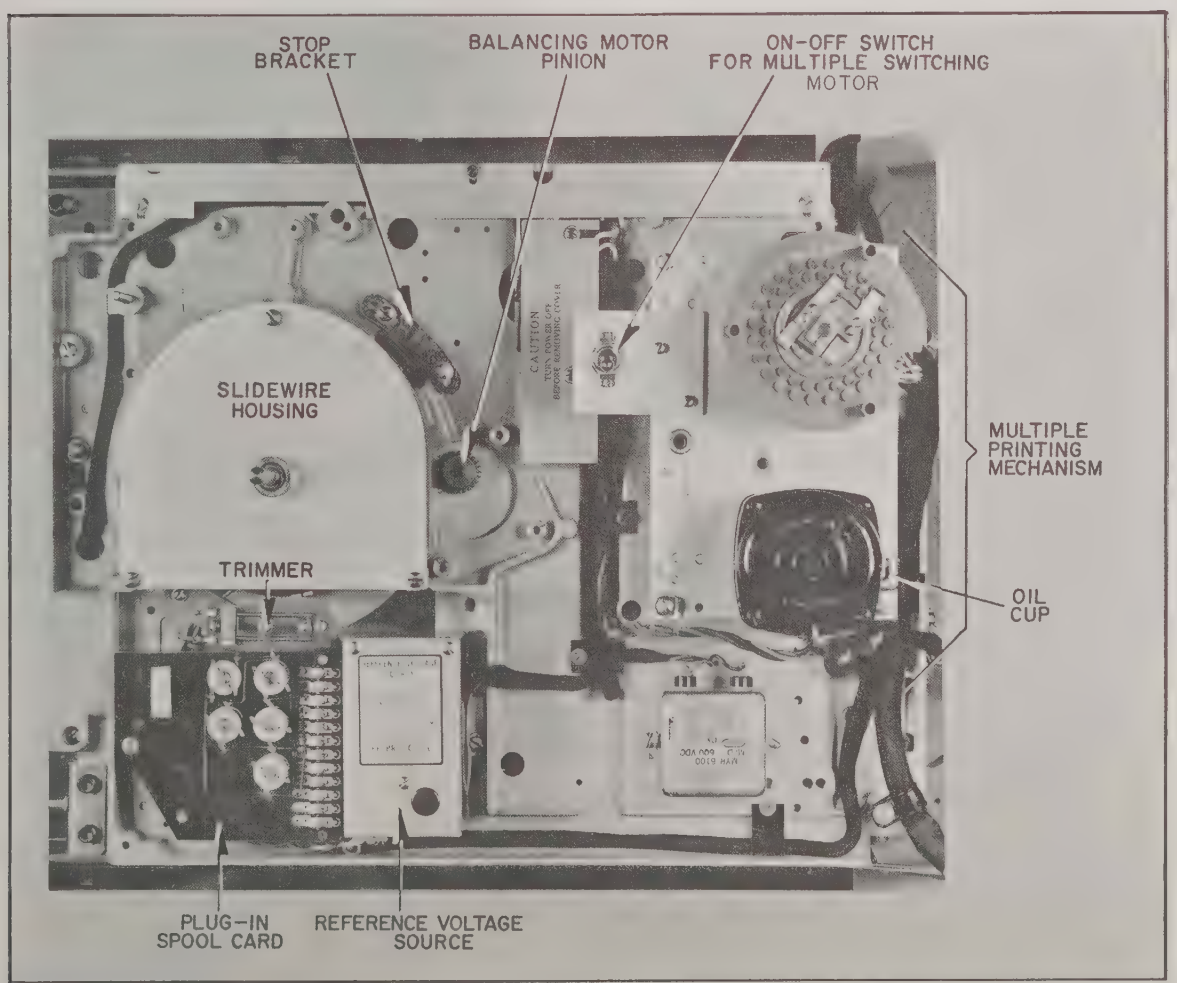


FIGURE 6. BACK OF PANEL, MULTIPLE-POINT DYNAMASTER POTENTIOMETER

as the adjusting nut. This prevents the shaft from turning while the adjusting nut is being turned.

If the chart tends to tear on the right side of the holes, turn adjusting nut in a counterclockwise direction until chart feeds properly.

If the chart tends to tear on the back side of the holes, the rewind-spindle clutch is too tight. To loosen clutch, turn rewind-spindle clutch plate counterclockwise (see Fig. 5). There are 2 holes in this plate into which any small metal object (such as a nail or paper clip) can be inserted to turn it. (See Par. F.)

E. Setting the Mechanical Zero

All Bristol Dynamaster Wide-Strip Recorders shipped after December 15, 1953 will be adjusted to have a live zero. The mechanical stop on these instruments will be set so that the pen is mechanically stopped at a point .035" below the live zero. This mechanical stop is referred to as the stop bracket in Figures 5 and 6.

As rapidly as possible, all wide-strip charts will be reprinted with a dotted line .035" below the live zero to indicate the position of the mechanical stop.

On older instruments not already adjusted to a live zero, the following procedure should be followed in resetting the mechanical zero to the new charts.

Turn off instrument. Rotate the large drive gear until stop pin hits the low side of stop bracket. If pen is not on the dotted line, loosen screws holding stop bracket and shift bracket sufficiently to permit pen to be moved to rest on the dotted line. Then retighten screws holding stop bracket.

When it is necessary to install a new pen or drive cord, or whenever the setting of the pen carriage has been disturbed, the following procedure should be followed:

1. Turn off instrument.
2. Rotate the large drive gear until stop pin hits the low side of stop bracket.
3. Set pen on dotted line below the live zero, by loosening drive-cord clamp on top of pen carriage and slide pen carriage until pen is on the dotted line.
4. Tighten drive-cord clamp and turn on instrument.

F. Adjusting the Rewind-spindle Clutch

If the chart rewind tube slips or rewinds loosely when the Dynamaster is operating, tighten the rewind-spindle clutch (Fig. 5) by turning the rewind-spindle clutch plate clockwise. There are 2 holes in this plate into which any small metal object (such as a nail or paper clip) can be inserted to turn it.

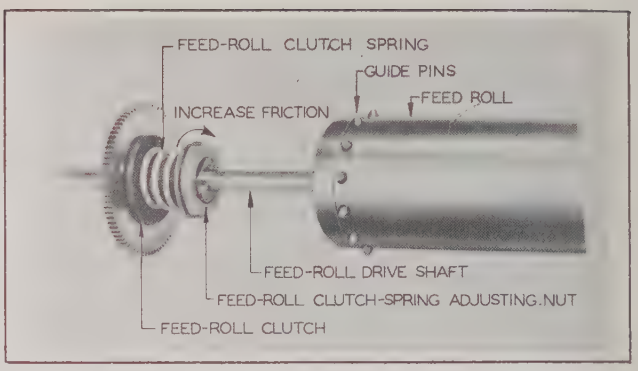


FIGURE 7. FEED ROLL CLUTCH

G. Adjusting the Feed-roll Clutch

The feed-roll clutch has been carefully installed at the Bristol factory and generally never requires adjustment. Under usual operating conditions, however, it may lose its friction. If it does not feed the chart smoothly at the correct rate, inspect the feed-roll clutch (Fig. 7) for slippage. By removing the rewind roll and turning the feed-roll knob, the clutch tension can be felt. The feed roll should **not** turn freely. If it does, the clutch is probably slipping.

To tighten the clutch, the entire feed roll must be removed. Take off the feed-roll knob and unscrew the setscrew in the feed-roll sprocket so that the sprocket turns freely. Remove both threaded bushings with their lock nuts, being careful not to lose the bearings. Move the left end of the feed roll out beyond the chart-assembly bracket and withdraw it from the drive sprocket. Push the feed-roll drive shaft through the feed roll until the clutch-spring adjusting nut is accessible. Tighten the ad-

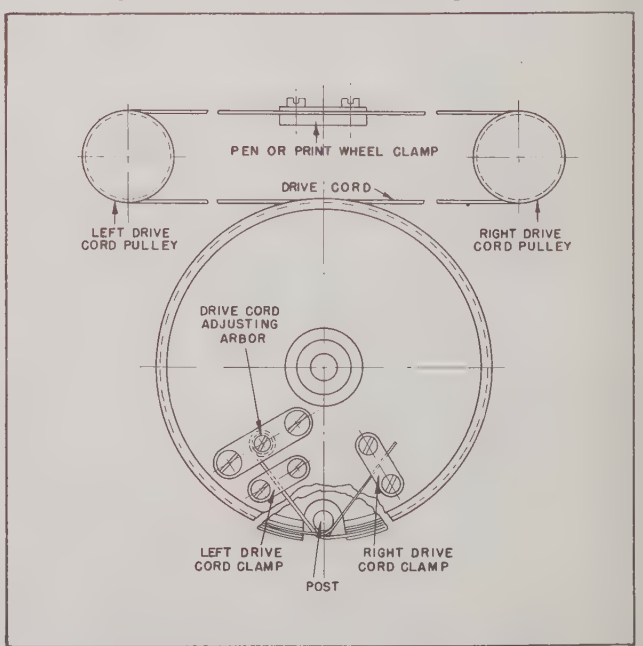


FIGURE 8. DRIVE CORD INSTALLATION DRAWING

justing nut until the clutch tension is sufficient to feed the chart correctly.

H. Replacing or Adjusting the Pen or Print-wheel Drive Cord

To replace a broken or worn cord, loosen the drive-cord clamp on the drive-cord sheave, loosen the drive-cord clamp on the print-wheel or pen assembly and take out the old cord (Fig. 8). Turn the drive-cord sheave so that the clamps are at the bottom. Thread one end of the new cord under the left drive-cord clamp and thru the adjusting arbor. Tighten clamp. Thread the cord around the post and the right-hand side of the sheave (in the rear groove), around the left drive-cord pulley, thru the hole in the left-hand scale bracket, thru the hole in the right-hand scale bracket, around the right drive-cord pulley, around the left-hand side of the sheave (in the front groove), around the post, thru the right drive-cord clamp on the sheave. Tighten the clamp. Make sure that the cord is on all the pulleys, then turn the adjusting screw clockwise to tighten the cord to the proper tension. It should be tight enough to prevent backlash but not so tight as to cause the drive-cord pulleys to bind. Tighten the left drive-cord clamp and clip off any excess cord which may remain beyond the arbor.

Now clamp the print-wheel or pen assembly to the cord. Be sure that the print wheel or pen is correctly zeroed by turning the main drive gear by hand until it hits the low stop. Center the pen or print wheel exactly on the lowest division of the chart (usually zero) and clamp the drive cord securely. (See Par. E. page 6).

J. Changing Chart Speeds

To change the chart speed on a Bristol Widestrip Dynamaster, first remove the change-gear lock nuts and the change gears from their shafts. (See Fig. 9).

Find the chart-drive motor behind the chart plate and determine the make and speed of the motor from its nameplate. The nameplate is located on the end of Telechron motors and on the top of Holtzer Cabot motors.

Find the column for the particular motor you have in the table Fig. 21 of Parts List P12055-A. Read down that column to find the desired chart speed; then read across the table to the right to find the gear train required.

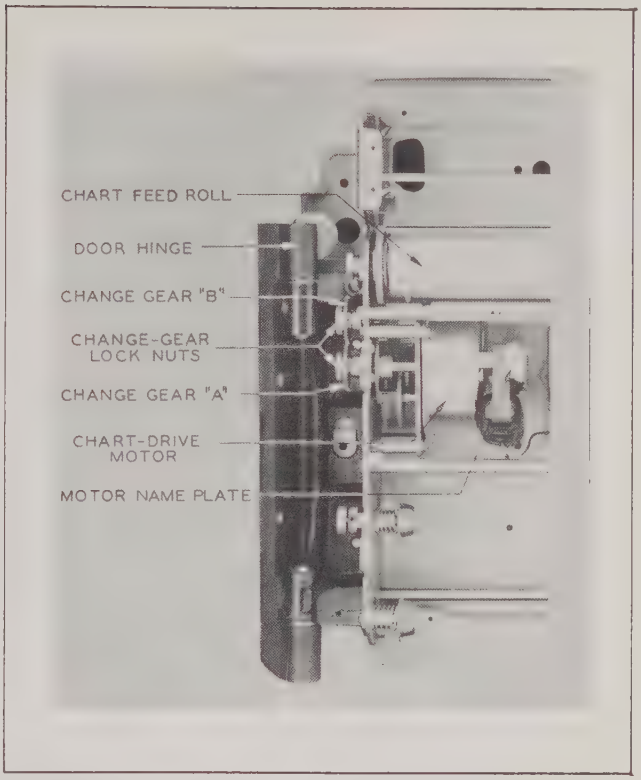


FIGURE 9. LEFT SIDE OF HINGED PANEL WITH CHART PLATE REMOVED

The number of teeth and the pitch should be marked on all gears with 32 or more teeth. If two gears with the same number of teeth are not marked for pitch, the smaller one is 48 pitch.

Put the gears on their respective shafts, making sure the "A" gear goes on the lower shaft. Be sure the slots in the gears engage the keys on the hubs so that they will not slip. Lock them in place with the change-gear lock nuts.

Note: If there do not appear to be enough gears for all the desired chart speeds, remember that each set of gears will give two speeds, depending on which gear is used as the "A" gear.

Spare chart-drive change gears are mounted on a stud located on the back of the hinged panel (upper left corner).

INSTRUCTION NO. P12169-1
(Issue of 11/61)

OPERATION OF EXTENDED RANGE-CHANGE MECHANISM
ATTACHMENT T162X

Herewith: Schematic Wiring Diagram - 017363-S

A multipoint switch for switching the Dynamaster bridge circuit is driven by a motor thru a Geneva mechanism to a position of proper measurement. The motor is operated by a circuit consisting of a high and low switch operated by the measuring circuit potentiometer shaft in conjunction with two limit switches and an interrupter switch on the Geneva drive unit.

When the Geneva mechanism is on a range contact and the motor is stopped, contact A is closed and switches B and D are closed unless the limit of range is exceeded. Switch A opens each time the Geneva mechanism switches into a range measurement position to stop motor J. When switch A closes, relay RX becomes energized and its contact RX closes causing the Geneva mechanism to reposition after a delay of two seconds.

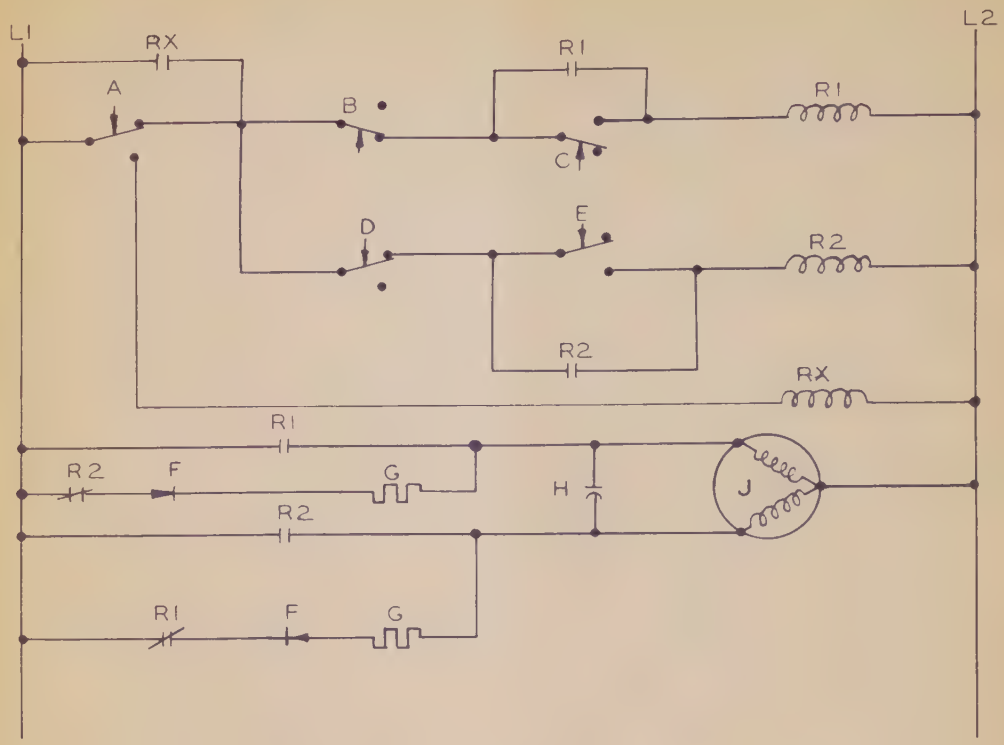
If the measured value is at the bottom of scale, switch C will operate to energize relay R1 and lock-in. The motor J will run to operate range switch to lower range and if switch C is open, relay R1 drops out thru interruption of switch A. With R1 deenergized direct current is applied to the motor thru normally closed contact R2 to give braking.

If switch C remained closed, relay R1 would energize to shift the mechanism to a lower range.

On measurement going high, switch E will close and operate relay R2 to run the motor in reverse direction to position the Geneva switch deck to a higher range. Operation is identical to lowering range.

THE BRISTOL COMPANY
WATERBURY 20, CONNECTICUT, U.S.A.

R1 & R2—RELAYS 53962
A———GENEVA INTERRUPTER SWITCH
B———LOW LIMIT OF GENEVA
C———LOW RANGE SWITCH
D———HIGH LIMIT OF GENEVA
E———HIGH RANGE SWITCH
F———RECTIFIER 51PP35
G———RESISTOR 14PP32
H———CAPACITOR 90059
J———MOTOR B1279
RX———RELAY 12PP30 (2 SEC.)



SCHEMATIC WIRING DIAGRAM

FOR WIDE-STRIP DYNAMASTER EXTENDED-RANGE RECORDER (ATTACHMENT T162X)

B. CO. ORDER NO. | CUSTOMER ORDER NO. | SERIAL NO.

			11-22-61	REVISION DATES
			8-7-59	

THE BRISTOL COMPANY
WATERBURY, CONN., U. S. A.
DRAWN J.A.D. TRACED
DATE 6-30-59 DRAWER NO. 122
SHEET NO. 017363-S

PARTS LIST P12055-A
Issue of January 1966

PARTS LIST
BRISTOL MODEL 560 AND 570
WIDE STRIP DYNAMASTER RECORDER

CONTENTS

	Page
Door Assembly	2-3
Case and Case Interior	2-3
Interior of 0.4 Second Instrument	4
Front of Hinged Panel	5
Rear of Hinged Panel	6-7
Chart-Drive Mechanism	8-9
Chart-Drive Motors	10-11
Pen Assembly for Single-Pen Recorder	12-13
Pen Assembly Support for Single-Pen Recorder	12-13
Pen Assembly for Two-Pen Recorder	14-15
Pen Assembly Support for Two-Pen Recorder	14-15
Multiple-Printing Mechanism	16-17
Multiple-Printing Mechanism Support	16-17
Balancing Mechanism for No. 2 Pen of 2-Pen Recorder	18-19
Multiple-Switching Mechanism	20-21-22
Table of Motors and Change Gears for Multiple-Switching Mechanism	22
Table of Motors and Change Gears for Chart Drive	23
Table of Motors and Change Gears for 2-Speed Chart Drive	23
Automatic Standardization Timer	24
Constant Voltage Unit	24
Power Pack (for d-c Resistance Recorder)	24
Automatic Pen Lifter	24
Pen Accessories	24
Extra Parts for 25-Cycle Instruments	24

THE BRISTOL COMPANY Waterbury, Connecticut 06720

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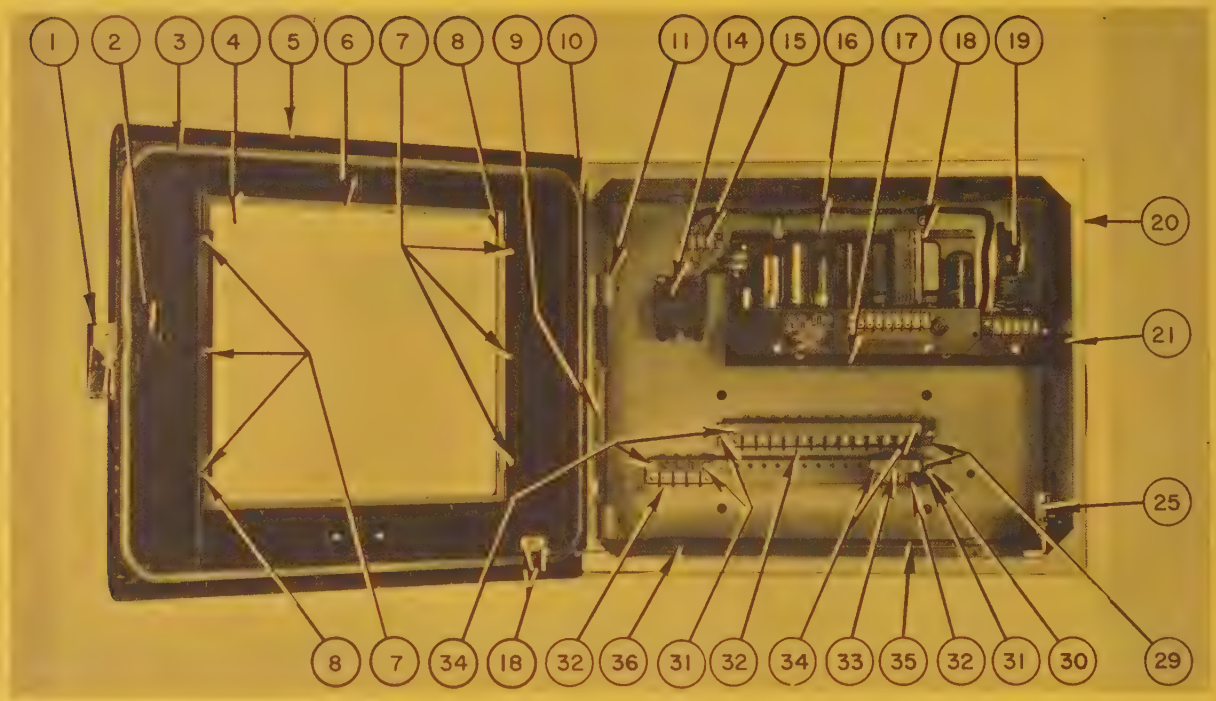


FIGURE 1. DOOR AND CASE INTERIOR

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
1	82615	Handle complete
	*87239	Stop pin
	*94738	Latch plate
2	88751	Hook complete
	82415	10-32 x 1/4" Bristo cup-point setscrew
	*82630	Flat spring
3	82608	Rubber gasket (62" long)
4	83644	Glass
5	85202	Door complete (for 560 & 570 cases) including items 1 thru 4 and 6 thru 8
	83057	Door only, order drilled per spec. 85203
6	84725	Gasket (47" long)
7	82656	6 x 3/16" Fillister-head screw
8	85232	Glass clip
9	85236	Hinge bracket
	*66539	10-32 x 3/8" Fillister-head screw
	*66541	10-32 x 1/2" Fillister-head screw
	*82413	10-32 x 3/16" Bristo flat-point setscrew
10	82654	Door hinge
	*92693	10-32 x 7/16" Flat-head screw
11	83996	Hinge for hinged panel on 1-pen and multiple-point instruments
	C1078	Hinge for hinged panel on 2-pen instruments
	*85208	Hinge pin
	12721	Washer
14		Input transformer
	B2776	for 10,000 ohm input 50-60 cycle — used with SPDT Syncroverter part C1415-1
	B2776-1	for 1,000 ohm input 50-60 cycle — used with SPDT Syncroverter part C1415-1
	B2776-2	for 100 ohm input 50-60 cycle — used with SPDT Syncroverter part C1415-1
	B2776-3	for 60,000 ohm input 50-60 cycle — used with SPDT Syncroverter part C1415-1
	B2171	for 200,000 ohm input 50-60 cycle — used on older instruments with DPDT Syncroverter part 89189
	92758	for 10,000 ohm input 50-60 cycle — used on older instruments with DPDT Syncroverter part 89189
	91934	for 1,000 ohm input 50-60 cycle — used on older instruments with DPDT Syncroverter part 89189
	94202	for 500 ohm input 25 cycle — used on older instruments with DPDT Syncroverter part 89189
	92759	for 100 ohm input 50-60 cycle — used on older instruments with DPDT Syncroverter part 89189

*Not Shown

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENTS WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
	31427	6-40 x 5/16" Fillister-head screw
	56498	Post
	92726	Shield
15	A4533	Terminal block (3 point)
	89131	Terminal block (2 point)
	*58073	6-40 x 7/16" Fillister-head screw
16	90640	Series C amplifier for 50-60 cycles (see parts list P12075 for breakdown)
	93956	Series C amplifier for 25 cycles (see parts list P12075 for breakdown)
	97600	Series C-1 amplifier for 60 cycles (see parts list P12077 for breakdown)
	C1551	Series C-3 amplifier for 60 cycles used with att. T100.
	C1646	Series C-4 amplifier for 50 cycles
	C1096	Series D amplifier for 60 cycles (see parts list P12077 for breakdown)
	C1552	Series D-2 amplifier for 60 cycles used with attachment T100.
	C1650	Series D-3 amplifier for 50 cycles
	C2366	Series "L10" amplifier for 60 cycles (see parts list P12609 for breakdown)
	C2914	Series "L11" amplifier for 50 cycles (see parts list P12609 for breakdown)
	C2915	Series "L12" amplifier for 60 cy. with auxiliary gain control. } see P.L. P12609
	C2916	Series "L13" amplifier for 50 cy. with auxiliary gain control. } for breakdown
17	89124	Amplifier shelf
	C1667	Amplifier shelf (C-5 only)
18	40066	8/32 x 1/4" Fillister-head screw
19	C1415-1	Syncroverter switch
	89189	Syncroverter (used on 25 cycle and on older instruments)
20		Case body complete (includes items 9, 21 and 25)
	93999	for 560 single-pen and multiple-point instruments
	85201	for 560 case body only (drilled and tapped)
	95644	for 570 single-pen and multiple-point instruments
	95645	for 570 case body only (drilled and tapped)
	D1099	for 570 2-pen instrument
	D1098	for 570 case body (drilled and tapped)
21	92126	Roller
	*96127	Roller stud
25	85220	Latch complete for hinged panel
	89659	1/4" - 20 x 3/8" Hexagon socket-head cap screw
29	86092	Terminal mounting strap (11 7/8" long)
	86093	Terminal mounting strap (8 13/16" long)
30		Terminal strap mounting post
	34954	1/2" long
	88102	1 1/4" long
	88106	2" long
	89869	2 3/4" long
31		Terminal strap mounting screw
	66568	10-32 x 3/4" Flat-head screw
	66545	10-32 x 3/4" Fillister-head screw
	66572	10-32 x 1 1/2" Flat-head screw
	65984	10-32 x 1 1/2" Fillister-head screw
	66575	10-32 x 2 1/4" Flat-head screw
	88107	10-32 x 2 1/4" Fillister-head screw
	89870	10-32 x 3" Round-head screw
32		Terminal blocks
	74804	2 terminals
	87235	3 terminals
	87236	4 terminals
	93670	5 terminals
	87238	6 terminals
	76643	8 terminals
	85288	9 terminals
	88098	12 terminals
33		Terminal marking strip (give marking and number of terminals)
34	87936	#10 x 1" Self-tapping screw
	*72166	Spacer
	*10075	Washer
35	86026	Rubber grommet (for 1 11/16" conduit hole)
	72691	Rubber grommet (for 1 1/16" conduit hole)
36	87392	Door-stop screw
	44739	Collar
	86027	Door stop
		Case Mounting Brackets
	*92030	Bracket
	*32193	1/4" - 20 x 1/2" Hex-head screw for mounting bracket to case
	*83848	5/16" - 24 x 2 1/2" Headless screw for flush-mounted case
	*50706	5/16" - 24 Hex nut for screw 83848
	*92031	Cup washer for screw 83848

*Not Shown

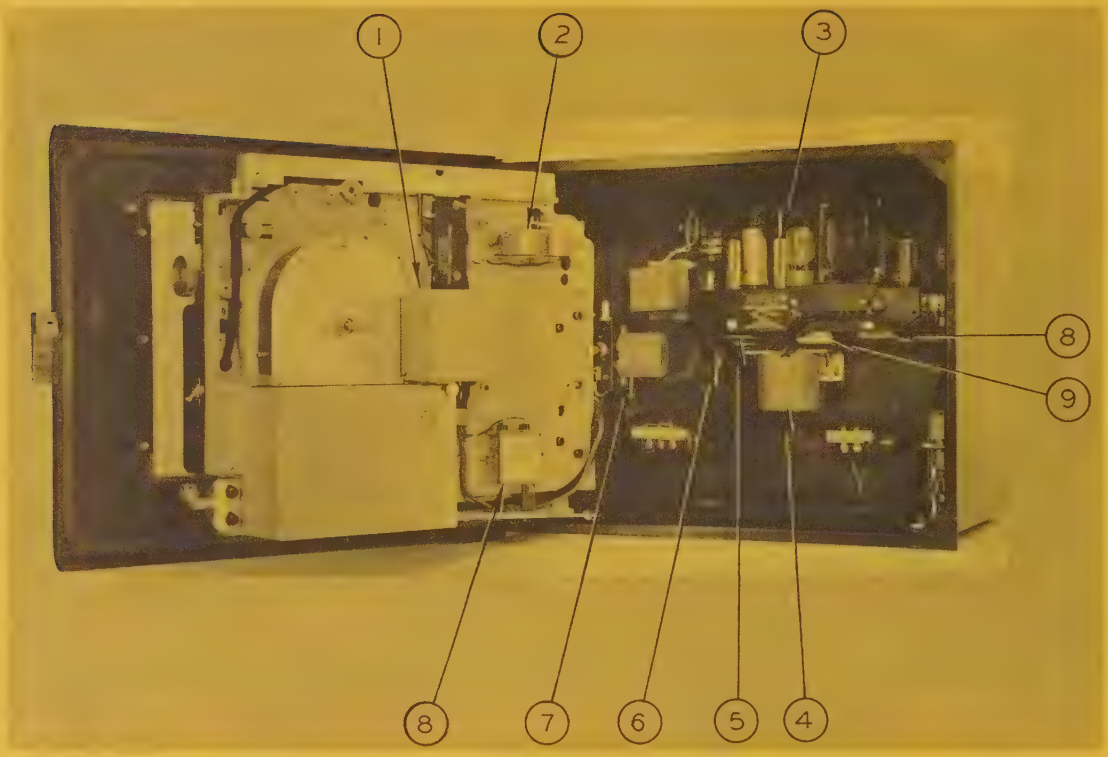


FIGURE 2. PHOTO OF HIGH-SPEED (0.4 SEC.) DYNAMASTER

ITEM	PART NO.	DESCRIPTION
1	B2162	Feed-back generator complete (order assembled per sheet OC1042)
	A2231	Balancing-motor mounting plate
	26966	8-32 Hex nut for mounting balancing motor
	93325	Generator-plate mounting post
	A4988	Pinion and flexible coupling
	66562	10-32 x 3/8" flat-head screw for mounting generator plate
	93327	Adjustable plate for mounting generator motor
	66536	8-32 x 3/16" Fillister-head screws for mounting adjustable plate
	84190	Barber-Coleman motor (generator)
	93329	Generator cover post
	93328	Generator cover
	63382	5-40 x 3/16" Fillister-head screw for mounting cover
	A8351	Integral feed-back generator & balancing motor
2	93347	Rectifier for pen-lifter relay
	*18339	6-40 x 3/16" Fillister-head screw for mounting rectifier
3	C1096	Series "D" amplifier (see parts list P12077 for breakdown)
4	92736	Output transformer
	*66537	10-32 x 1/4" Fillister-head screw for mounting transformer
	*35638	#10 Lockwasher
5	A3820	Thyrite disk complete (used with B2162 only)
	*62290	6-40 x 1 1/16" Fillister-head screw for mounting Thyrite disk
	*43040	Washer
	*A2241	Spacer
	*20903	6-40 Hexagon nut
6	A2517	Stick resistor (used with B2162 only)
	*92315	6-40 x 2" Fillister-head screw for mounting stick resistor
	*43040	Washer
	* 256	Retaining washer
7	B1216	Feed-back unit complete (used with B2162 only)
	93307	Transformer
	91050	Rheostat (60 ohm)
	A2242	Rheostat (2 meg.)
	83979	Resistor (470K, 1/2 watt)
	90575	Resistor (10K, 1 watt)
	84549	Potentiometer cap
	B2702	Feedback unit complete (used with A8351 only)
8	93740	Capacitor (1.25 mfd. 600 V.)
	*66537	10-32 x 1/4" Fillister-head screw for mounting capacitor
	*35638	#10 Lockwasher
9	74480	Capacitor (.5 mfd. 600V.)

*Not Shown

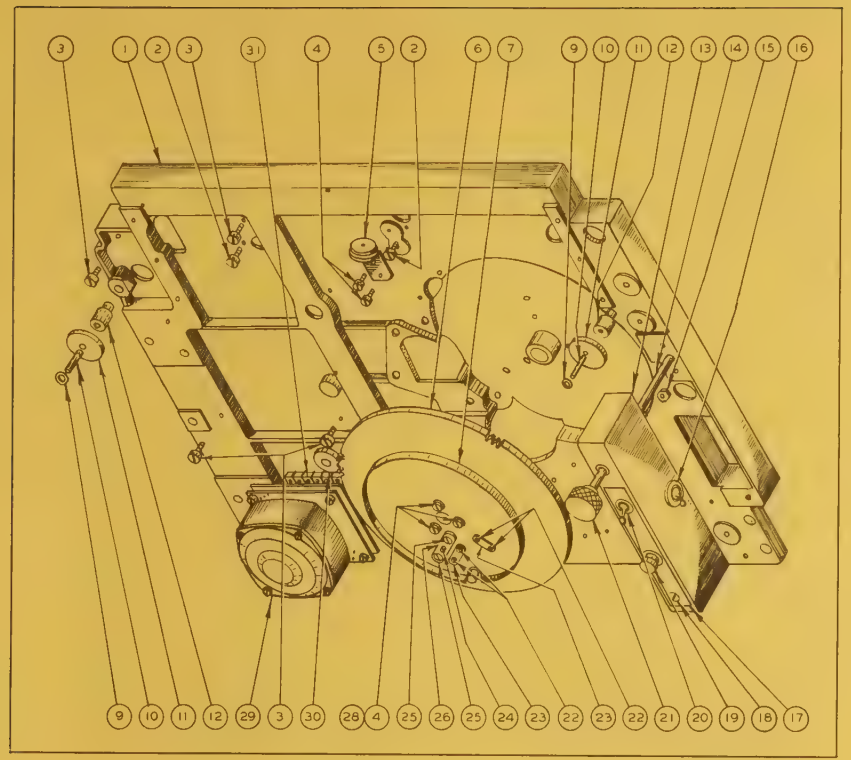


FIGURE 3. FRONT OF HINGED PANEL

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
1	98350	Mounting frame for 1-pen and multiple point instruments
	B1151	Mounting frame for 2-pen instruments
2	66539	10-32 x 3/8" Fillister-head screw
3	66539	10-32 x 3/8" Fillister-head screw for 2-pen instruments
	42098	10-32 x 7/16" Fillister-head screw for multiple-point instruments
4	31427	6-40 x 5/16" Fillister-head screw
5	88183	Pulley and bracket complete
	76283	Pulley
	79854	Retaining ring
6	92578	Bull gear complete for 3, 4.5, 7 and 24 second pen travel, includes setscrew and items 4, 7, 22 thru 26 and 28
	86052	Bull gear and hub only for 3, 4.5, 7 and 24 second pen travel
	93929	Bull gear complete for 1 and 0.4 second pen travel, includes setscrew & items 4, 7, 22 thru 26 & 28
	93360	Bull gear and hub only for 1 and 0.4 second pen travel
	89049	5/16-18 Flat-point setscrew
	B2445	Bull gear for new style 0.4 second
7	85255	Sheave
	89030	Drive cord
9	80607	Retaining ring (1/8" shaft) (see item 11)
10	85291	Pulley shaft (see item 11)
11	92579	Cord-pulley assembly complete including setscrew and items 9, 10 and 12 for 3, 4.5, 7 and 24 sec. pen travel
	A2205	Cord-pulley assembly complete including setscrew and item 12 for 1 and 0.4 second pen travel
	82403	Setscrew for item 11
12	85292	Mounting stud for 3, 4.5, 7 and 24 second pen travel (see item 11)
	A2210	Mounting stud for 1 and 0.4 second pen travel (see item 11)
13	86025	Switch housing for 1-pen and multiple-point instrument
	92934	Switch housing same as above, but drilled for 2-speed chart-drive switch
	B1557	Switch housing for 2-pen instrument
14	88175	Control-knob shaft
15	72055	10-32 Hexagon nut
16	62827	2-speed chart-drive switch
17	86098	Switch plate for d-c Potentiometer type instrument (2 switches)
	86099	Switch plate for a-c bridge type instrument (1 switch)
18	91089	6-40 x 1/4" Fillister-head screw
19	54261	Push-button switch
20	62182	Toggle switch (on-off)
21	89132	Control knob
	82413	10-32 x 3/16" Flat-point setscrew
22	39770	6-40 x 1/4" Fillister-head screw
23	85319	Cord clamp
24	76273	Tension shaft
25	20021	6-40 x 1/4" Flat-head screw
26	76276	Tension-shaft clamp
28	43040	#6 Lockwasher
29		Balancing motor assembly
	96871	0.4 second pen-speed motor (120 volt, 50-60 cycle) old style
	A8351	0.4 second combination balancing motor-feedback generator
	A4989	Pinion
	96873	1-second pen-speed motor and gear train complete
	96871	1000 rpm motor (120 volt, 50-60 cycle)
	97638	Gear complete (72T-64P)
	A1546	Pinion
	B1878	1-second pen speed worm gear drive complete
	C1598	Motor only
	A4567	Worm only
	A4564	Clutch assembly
	96848	3-second pen-speed motor and gear train complete
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96868	Gear complete (88T-64P)
	96849	4.5-second pen-speed motor with pinion (120 volt, 60 cycle)
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96859	Gear complete (140T-64P)
	93699	7-second pen-speed motor (120 volt, 25 cycle)
	B1424	12-second pen-speed motor complete
	96872	1000 rpm motor
	97647	Gear complete (120T-48P)
	A3425	Pinion and gear
	96874	24-second pen-speed motor and gear train complete
	96872	1000 rpm motor (120 volt, 60 cycle)
	97652	Gear complete (88T-64P, 15T-48P)
	97647	Gear complete (120T-48P)
30		Motor pinion
	91930	for instruments with 24-second pen travel
	91930	for instruments with 12-second pen travel
	86036	for instruments with 7-second or 4.5-second pen travel
	91932	for instruments with 3-second pen travel
	A4988	for instruments with 0.4-second pen travel
	86029	Terminal block
	86031	Marking strip
	45081	Spacers
	41519	Screws
	86030	Cover
	10075	Washer
	43040	Washer

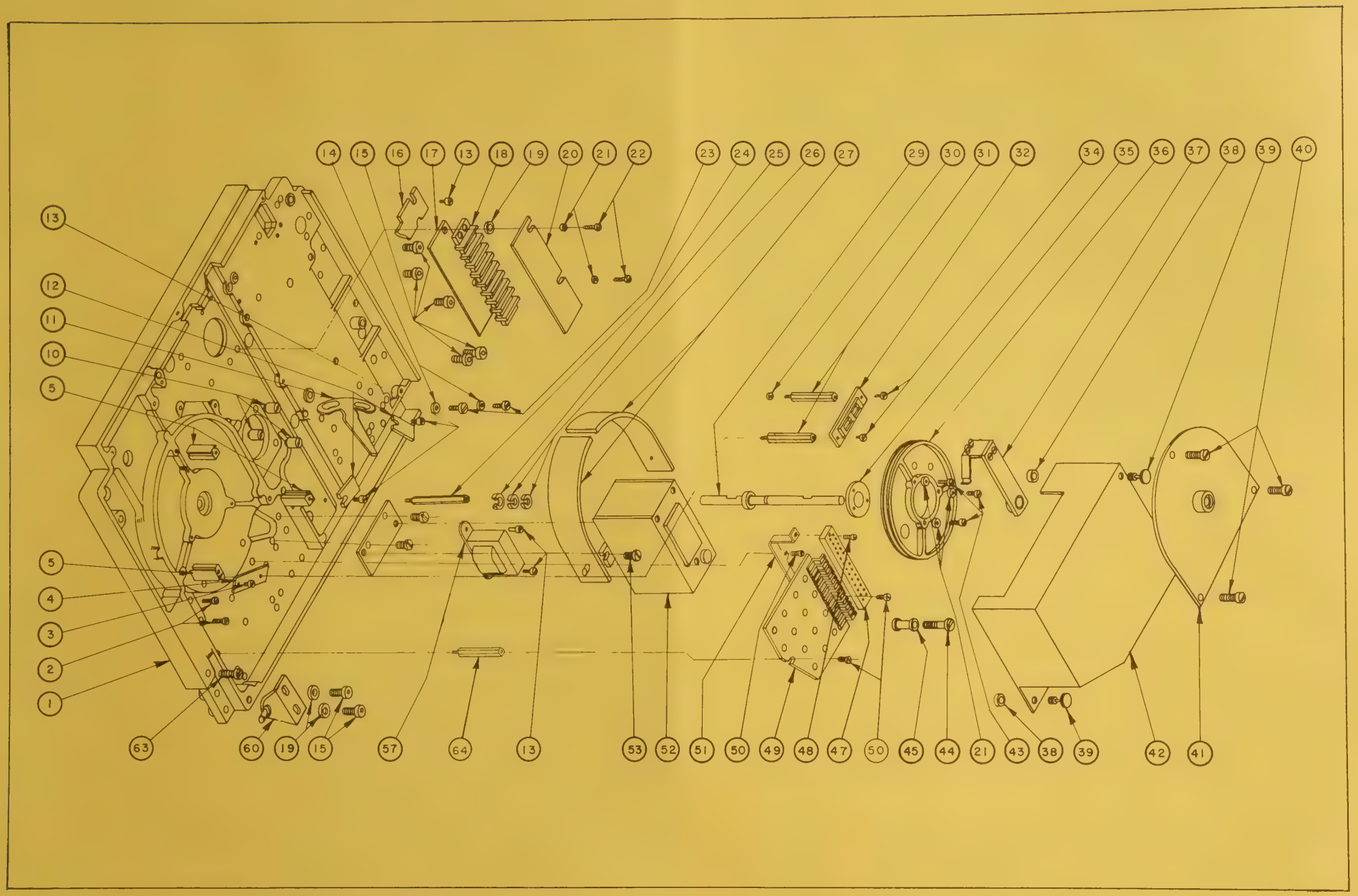


FIGURE 4. REAR OF HINGED PANEL

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENT WHEN ORDERING PARTS

ITEM	PART NO.	DESCRIPTION
1	98350	Mounting frame
2	66541	10-32 x 1/2" Fillister-head screw
3	91089	6-40 x 1/4" Special-head screw
4	89118	Clamp
5	89112	Post
10	86053	Motor mounting nuts
11	85272	Gear stop
12	85273	Cable clamps
13	39770	6-40 x 1/4" Fillister-head screw
14	10075	Washer
15	89660	1/4"-20x 1/2" Hex-cap screw
16	91678	Cable cover
17	95612	Terminal block marking strip (8 point)
18	95611	Terminal block
19	45081	Spacer
20	95614	Cover, terminal block
21	43040	#6 Lockwasher
22	41519	6-40 x 3/4" Fillister-head screw
23	66539	10-32 x 3/8" Fillister-head screw
24	86014	Post
25	A5078	Thrust washer
26	89117	Retaining ring
27	89865	Cover for slidewire
	A3805	Cover for slidewire (used on .4 second instruments)
29	93034	Balancing mechanism shaft (560)
	96809	Balancing mechanism shaft (570) deep case only
	A4010	Balancing mechanism shaft((570 double front set)
	A4008	Balancing mechanism shaft (573 & 574 0.4 sec. instruments)
	A5080	Bearing
30	95425	Washer
31	95424	Post
32		Slidewire trimmer, give model, range and serial number of instrument
34	51556	4-48 x 5/16" Fillister-head screw
35	A5079	Cover plate for bearing
	A1872	Mounting screws
36		Slidewire complete, specify model, range and serial number of instrument
37	95639	Contact arm for ac-dc instruments
	B1464	Contact arm only for above
38	82381	Washer
39	55785	10-32 Special thumb screw
40	65984	#10-32 x 1 1/2" Fillister-head screw
41	89104	Cover for slidewire
42	89113	1 or 2 pen ac-dc cover
	94857	Cover, battery standardizing dc only
43	19336	6-40 x 5/8" Fillister-head screw
	36344	6-40 x 5/8" Fillister-head screw for A-C instruments
44	40069	6-40 x 11/16" Fillister-head screw
45		Calibration spool, give model, range and serial number of instrument and information on label of spool
47	A4951	12-Point terminal block
48	91089	6-40 x 1/4" Fillister-head screw
49	A6016	Plug-in card
50	39770	6-40 x 1/4" Fillister-head screw
51	A7136	Mounting strap
52	B2766	Reference voltage source (Zener)(order with mounting feet A12239, 2 req.)
53	40066	8-32 x 1/4" Fillister-head screw
57	84245	Transformer (50-60 cycle) — Standard a-c bridges
	72557	Transformer (25 cycle) — Standard a-c bridges
	98090	Transformer (50-60 cycle) — As required for strain gauges
	A3830	Transformer (25 cycle) — As required for strain gauges
	91029	Transformer (50-60 cycle) — As required for conductivity
	76324	Transformer (25 cycle) — As required for conductivity
60	85296	Latch pin
63	47042	10-32 x 1 1/8" Fillister-head screw
64	88141	Post
	39770	6-40 x 1/4" Fillister-head screw

NOTE: See att. T111 when two plug-in cards are required.

ITEM	PART NO.	DESCRIPTION
		Chart drive complete, without motor
	79220	with aluminum roll
	82424	with rubber covered roll
	D1008	Swing out chart drive (for two-pen recorder)
1	72403	Retaining ring
2	35638	#10 Lockwasher
3	67029	10-32 x 5/16" Fillister-head screw
4	79208	Loading-spindle adjusting nut
	*82404	6-40 x 3/16" Flat-point setscrew for item 4
5	88885	Collar, not including setscrew
	*82404	6-40 x 3/16" Flat-point setscrew for item 5
6	39425	10-32 x 1/4" Special-head screw
7	79290	Bearing screw
8	66539	10-32 x 3/8" Fillister-head screw
9	79203	Foot for 1-pen and multiple-point instruments
	A2078	Foot for 2-pen instruments
10	79291	Bearing
11	11386	Hexagon nut
12	79288	End plate (left hand) for all instruments except those with swing-out chart drive
	B1465	End plate (left hand) for 2-pen instruments with swing-out chart drive
13	79243	Shaft and hub complete
14	79236	Clutch facing
14A	A5473	Washer
15	79241	Gear (80T-48P)
16	79237	Washer
17	79240	Spring
18	79235	Washer
19	79296	Chart-guide support rod (note: substitute item 43 for 2-pen instruments)
20	79295	Chart guide
	*30628	4-48 x 3/16" Fillister-head screw
21	94587	Spacer for chart cut-off plate
22	94030	Chart feed roll (aluminum)
	94031	Chart feed roll (rubber covered)
23	73927	2-64 x 7/32" Fillister-head screw
24	79231	Sprocket (26 tooth) not including setscrew
	*82414	10-32 x 1/4" Flat-point setscrew
25	83895	Bearing nut
26	83849	Sprocket (16 tooth)
27	21252	Washer
28	31427	6-40 x 5/16" Fillister-head screw
29	84743	Knob
	*A11378	10-32 x 1/4" Nyloc cup-point setscrew
30	43040	#6 Lockwasher
31	79289	End plate (right hand) for 1-pen and multiple-point instrument
	A2070	End plate (right hand for 2-pen instruments)
	*85216	Spring post — order assembled to end plate A2070
	*A2071	Latch lever — order assembled to end plate A2070
	*43184	Shim — order assembled to end plate A2070
	*A2074	Stud — order assembled to end plate A2070
	*85217	Stud — order assembled to end plate A2070
	*52618	Washer — order assembled to end plate A2070
	*42098	10-32 x 7/16" Fillister-head screw — order assembled to end plate A2070
	*85214	Latch spring for swing-out chart drive for 2-pen instruments
32	18339	6-40 x 3/16" Fillister-head screw
33	79205	Latch spring
	A2075	Latch spring for 2-pen instruments
34	79250	Rewind knob, not including setscrew
	*	10-32 x 1/8" Flat-point setscrew
35	79247	Thrust washer
36	95498	Rewind shaft
37	79257	Thrust washer
38	79253	Spring
39	79252	Sprocket (16 tooth) and hub
40	79248	Clutch facing
41	79256	Loading spindle
42	82380	Spring housing
43	79282	Brace rod
44	79238	Spring
45	79200	Spring-tension nut
46	79228	Chain

*Not Shown

(continued on page 9)

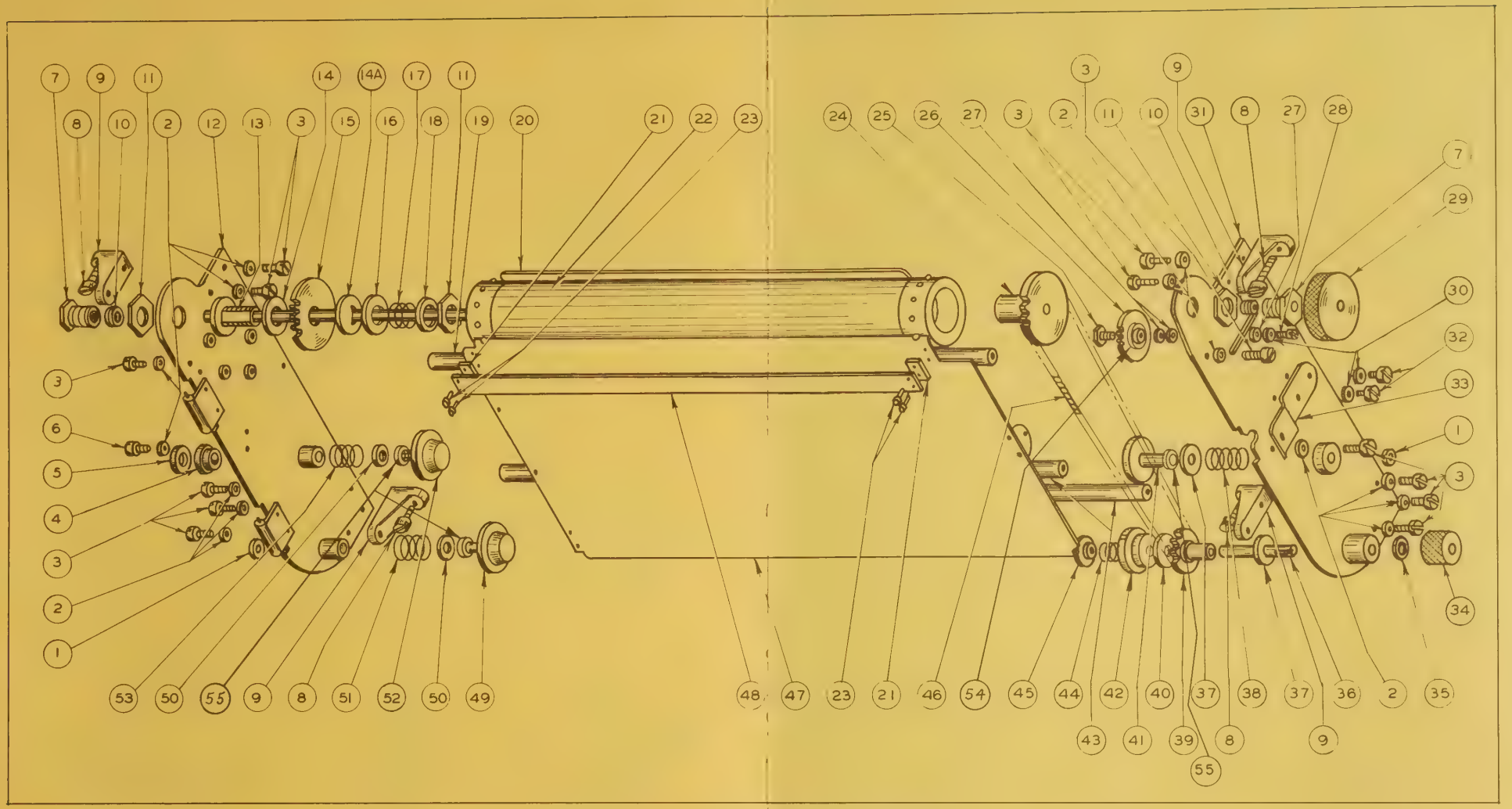


FIGURE 5. CHART-DRIVE MECHANISM WITHOUT MOTOR

ITEM	PART NO.	DESCRIPTION
47	79284	Chart plate (note: when used with chart cut-off guide, order drilled per sheet 94426)
48	94586	Chart cut-off guide
49	79263	Rewind spindle
50	79265	Spring collar
51	79264	Spring
52	A5077	Loading spindle
53	79232	Spring
	*63891	Chart rewind tube (cardboard)
	*86021	Chart clip
54	10075	Washer, fits over item 26
55	A5785	Washer

NOT SHOWN PARTS FOR SWING OUT CHART DRIVE FOR 2-PEN INSTRUMENTS

B1155	Hinge
66562	10-32 x 3/8" Flat-head screw for mounting hinge, part #31155
66539	10-32 x 3/4" Fillister-head screw for mounting hinge part #B1155
A2079	Hinge pin
B2414	10-32 x 1/4" Flat-point setscrew
B1502	Tie bar (Lower)
B1503	Tie bar (Upper)
96866	10-32 Shoulder screw
86324	10-32 x 1/2" Hexagon-socket cap screw

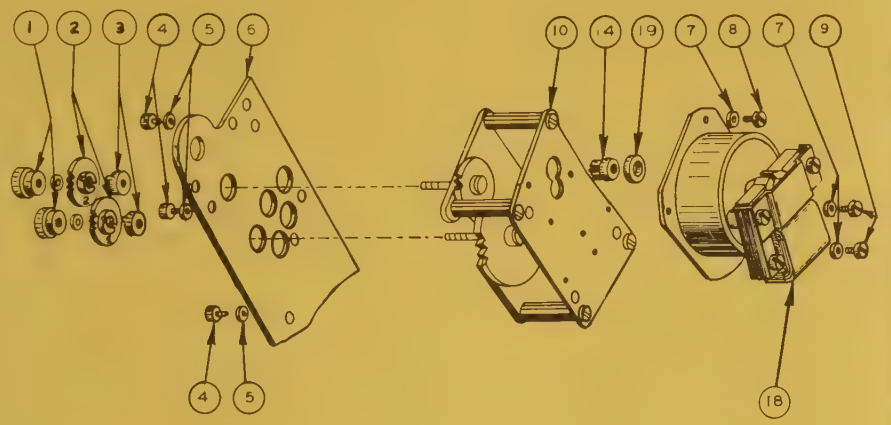


FIGURE 6. LOW-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 2- OR 4-RPM TELECHRON MOTOR

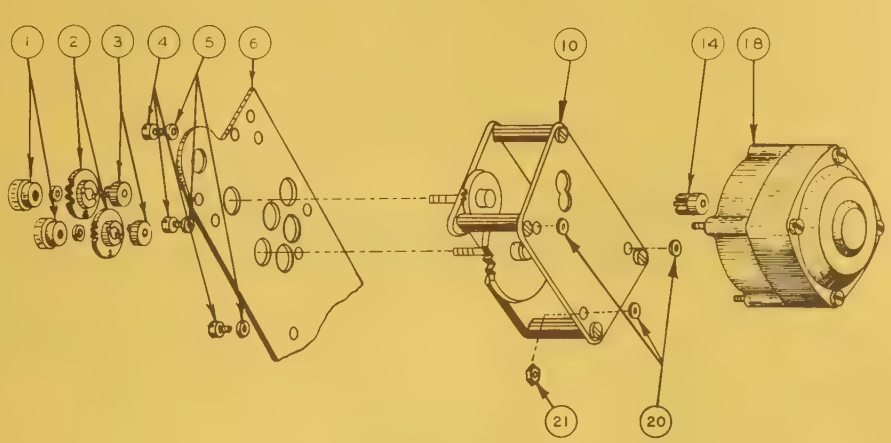


FIGURE 7. LOW-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 10- OR 60-RPM HOLTZER-CABOT MOTOR

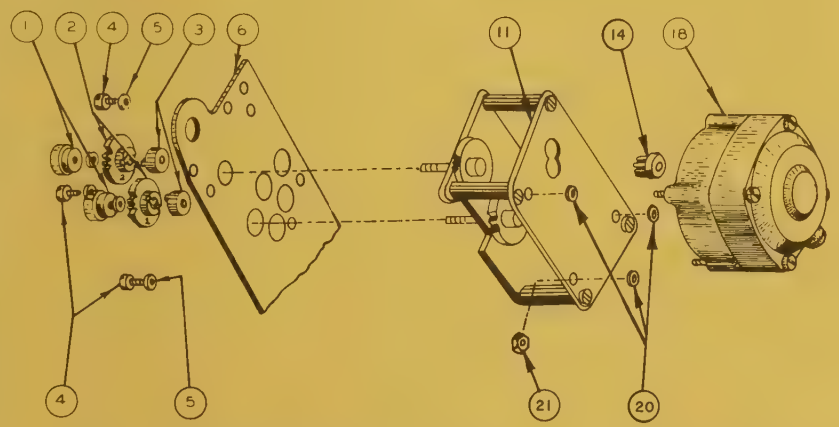


FIGURE 8. HIGH-SPEED CHART-DRIVE MOTOR ASSEMBLY USING 4-, 10- OR 60-RPM HOLTZER-CABOT MOTOR

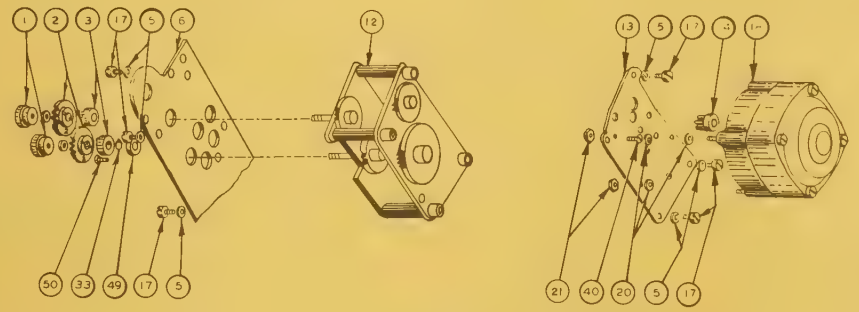


FIGURE 9. TWO-SPEED CHART-DRIVE MOTOR

ITEM	PART NO.	DESCRIPTION
1	79209	Knurled nut
	35638	Lockwasher
2		Change gears (see table figure 21)
3	79210	Change-gear collar, not including setscrew
	*82403	6-40 x 1/8" Flat-point setscrew for item 3
4	66372	#6-40 Shoulder screw
5	35638	#10 Lockwasher
6		Left-hand chart-drive plate (see figure 5, item 12)
7	43040	#6 Lockwasher
8	19536	6-40 x 5/8" Fillister-head screw
9	39770	6-40 x 1/4" Fillister-head screw
10	A9062	Gear train complete
11	A9061	Gear train complete
12		Gear train complete
	C1021	60:1 ratio
	C1022	30:1 ratio
	C1023	10:1 ratio
13	A1531	Mounting plate for two-speed chart-drive motor
14	53086	Motor pinion (14T-48P) (not including setscrew) for low-speed chart drive
	51590	Motor pinion (16T-48P) (not including setscrew) for high-speed chart drive
	A1532	Motor pinion (16T-48P) (not including setscrew) for 2-speed chart drive
	82403	6-40 x 1/8" Flat-point setscrew for above
17	66372	6-40 Shoulder screw
18	86058	Chart-drive motor, Telechron type C5 (120 volt, 60 cycle, 2 rpm)
	86059	Chart-drive motor, Telechron type C5 (120 volt, 50 cycle, 2 rpm)
	86060	Chart-drive motor, Telechron type C5 (120 volt, 25 cycle, 2 rpm)
	92110	Chart-drive motor, Telechron type C5 (120 volt, 60 cycle, 4 rpm)
	92111	Chart-drive motor, Telechron type C5 (120 volt, 50 cycle, 4 rpm)
	93963	Chart-drive motor, Telechron type C5 (120 volt, 25 cycle, 4 rpm)
	96738	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 60 cycle, 4 rpm)
	B2274	Chart-drive motor, Holtzer-Cabot type RBC2505 (120 volt, 50 cycle, 4 rpm)
	88060	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 60 cycle, 10 rpm)
	B2275	Chart-drive motor, Holtzer-Cabot type RBC2505 (120 volt, 50 cycle, 10 rpm)
	53680	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 60 cycle, 60 rpm)
	54603	Chart-drive motor, Holtzer-Cabot type RWC2505 (120 volt, 50 cycle, 60 rpm)
	92128	Chart-drive motor, Holtzer-Cabot type RWC2510 (120 volt, 60 cycle, 60 rpm)
	B1277	Chart-drive motor, Holtzer-Cabot type RBC2505 (120 volt, 60 cycle, 1 rpm)
	B1276	Chart-drive motor, Holtzer-Cabot type RBC2505 (120 volt, 60 cycle, 2 rpm)
	B1279	Chart-drive motor, Holtzer-Cabot type RBC2510 (120 volt, 60 cycle, 60 rpm)
	55327	Chart-drive motor, Bodine (120 volt, 60 cycle, 4 rpm)
19	79278	Locating ring
20	2420	Washer (3 required)
21	94855	8-32 Hex nut (3 required)
33	79854	Retaining ring
40	37751	6-40 x 5/8" Flat-head screw
49	13256	Collar
50	20335	6-40 x 5/16" Flat-head screw

*Not Shown

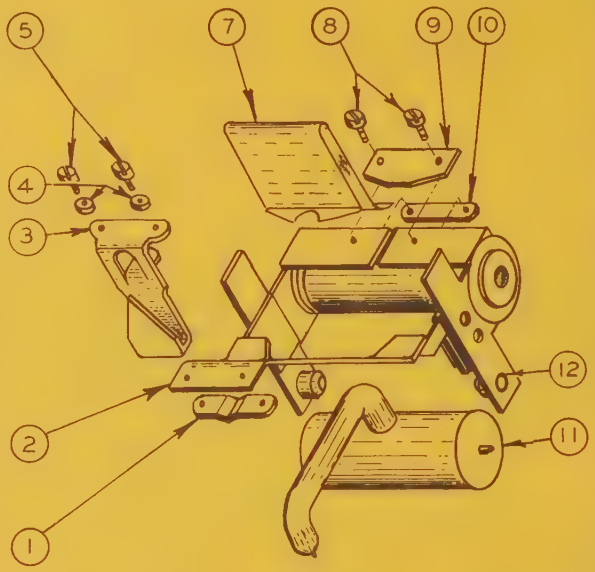


FIGURE 10. PEN ASSEMBLY FOR A STANDARD 1-PEN RECORDER

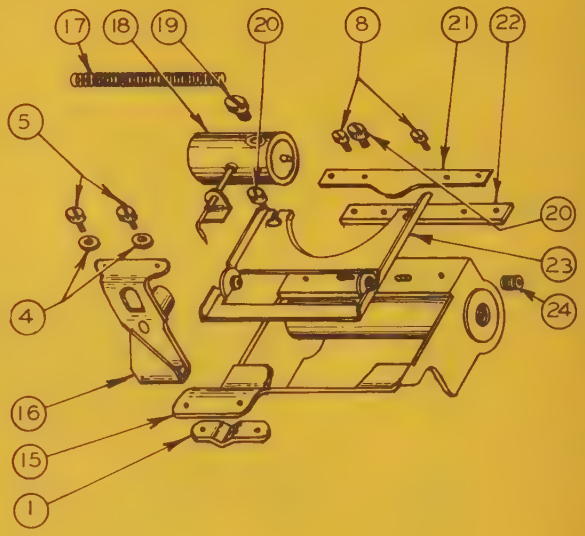


FIGURE 11. PEN ASSEMBLY FOR A 0.4 SEC. RECORDER

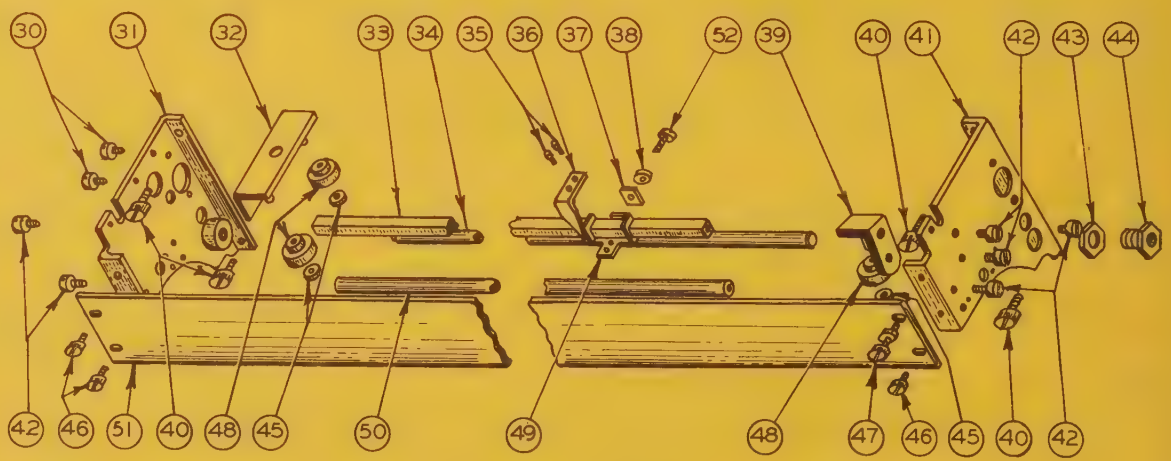


FIGURE 12. PEN-ASSEMBLY SUPPORT FOR A 1-PEN RECORDER

ITEM	PART NO.	DESCRIPTION
1	85230	Indicator clamp
2	93348	Pen-carriage assembly complete, less pen
3	85224	Indicator
4	37267	Washer
5	65071	3-56 x 1/8" Fillister-head screw
7	93358	Spring clip
8	30628	4-48 x 3/16" Fillister-head screw
9	85228	Cord clamp
10	85229	Strap
11	85206	Standard Pen (Glass)
	95377	Metal pen
12	A4595	Pivot screw
15	A2212	Pen-carriage assembly complete, less pen (for 0.4-second pen speed)
16	A2213	Indicator (for 0.4-second pen speed)
17	39890	Tension spring
18	A2200	Pen for 0.4-second pen speed (includes item 19)
19	A2211	Filler cap (included in item 18)
20	A2218	Thumb screw
21	A2222	Cord clamp
22	A2223	Strap
23	B1212	Pen mounting (includes item 24)
24	A2221	6-32 Pivot screw (included in item 23)
30	18339	6-40 x 3/16" Fillister-head screw
31	85298	Left-hand support bracket (standard)
	A2227	Left-hand support bracket complete (0.4-second pen speed)
	A2228	Left-hand support bracket only (0.4-second pen speed)
	A2225	Pen-stop bracket
	A1568	Pen-stop adjusting screw
	68556	10-32 Jam nut for adjusting screw
	47622	Washer for adjusting screw
	A1567	Bumper, on end of adjusting screw
	66537	10-32 x 1/4" Fillister-head screw, to mount bracket A2225
	35638	#10 Lockwasher for above screw.
32	88185	Control-index-pulley bracket complete (includes items 45 and 48)
33	88188	Control-index support rod
34	85271	Pen-support rod
35	93976	2-64 x 3/32" Fillister-head screw
36	88189	Control index
37	88191	Indicator-cord clamp
38	76293	2-64 Thumb nut
39	88181	Control-index-pulley bracket complete, (includes items 45 and 48)
40	66539	10-32 x 3/8" Fillister-head screw
41	85249	Right-hand support bracket (standard)
	A2224	Right-hand support bracket complete (0.4 second pen-speed)
	A2226	Right-hand support bracket only (0.4-second pen speed) for breakdown of pen-stop parts, see item 31 Part #A2227
42	39770	6-40 x 1/4" Fillister-head screw
43	85269	7/16"-27 Hex nut
44	85268	Bearing screw
45	79854	Retaining ring (3/16" shaft)
46	91089	6-40 x 1/4" Special-head screw
47	61682	6-40 Double-head screw
48	76283	Cord pulley
49	88190	Pointer bracket
	40018	2-64 x 1/4" Fillister-head screw
50	85256	Pen-carriage guide rod
51		Scale (order by model and serial number of instrument)
52	40018	2-64 x 1/4" Fillister-head screw

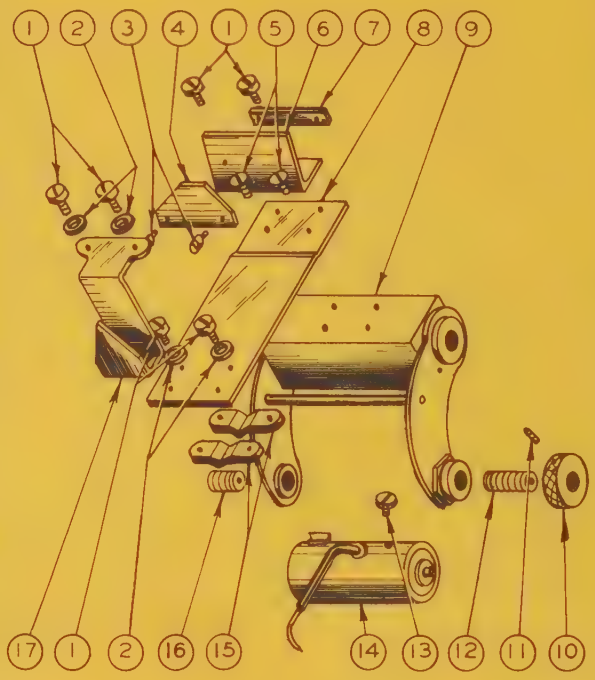


FIGURE 13. UPPER (NO. 2) PEN ASSEMBLY FOR 2-PEN RECORDER

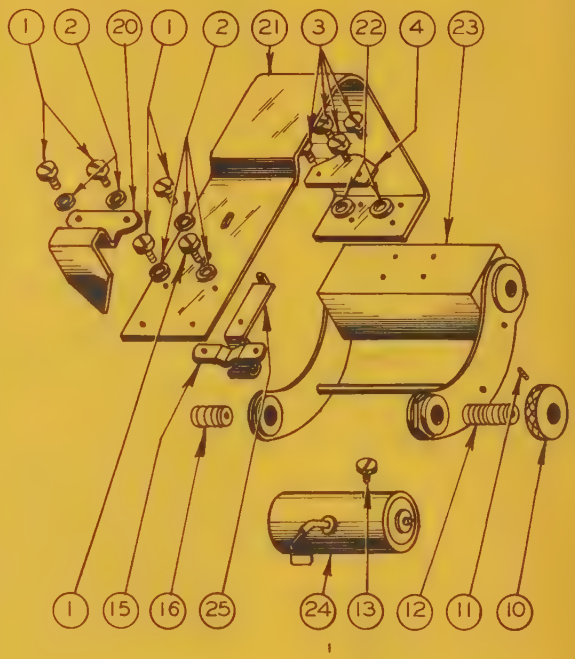


FIGURE 14. LOWER (NO. 1) PEN ASSEMBLY FOR 2-PEN RECORDER

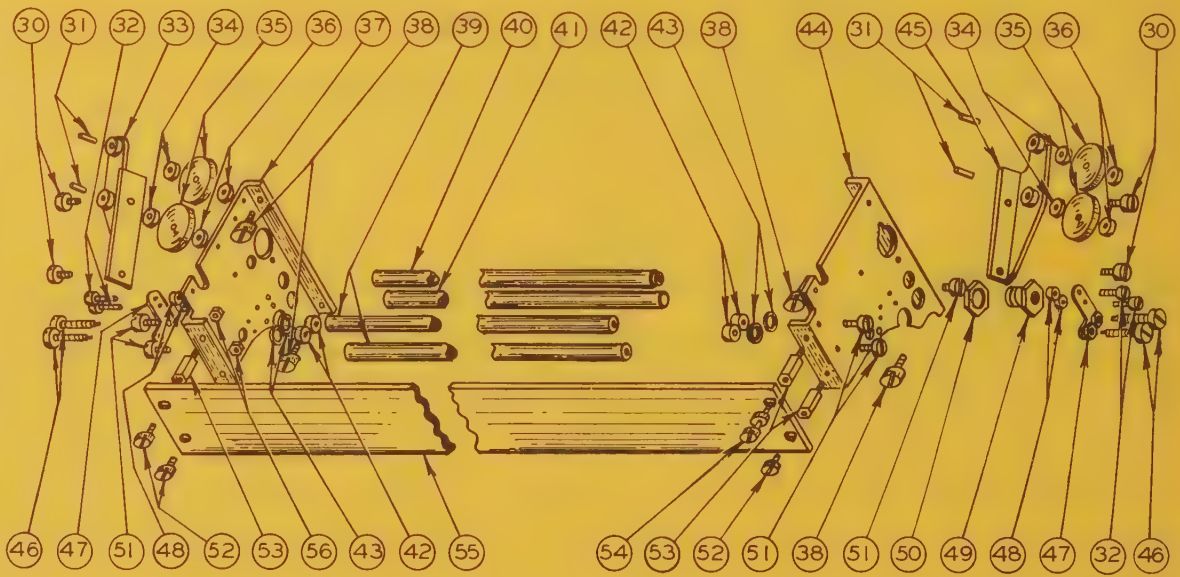


FIGURE 15. PEN ASSEMBLY SUPPORT FOR 2-PEN RECORDER

ITEM	PART NO.	DESCRIPTION
1	65071	3-56 x 1/8" Fillister-head screw
2	72103	Washer
3	61247	4-48 x 1/4" Fillister-head screw
4	85228	Cord clamp
5	20860	4-48 x 1/4" Flat-head screw
6	93399	Cord-clamp bracket
7	85229	Strap
8	A2090	Indicator bracket (#2 pen)
9	B1159	#2 Pen carriage (includes items 10, 11, 12 and 16)
10	A2083	6-32 Thumb nut
11		6-40 x 1/8" Cone-point setscrew
12	A2087	6-32 x 1/2" Pivot screw
13	A2101	Filler cap
14	B1162	#2 Pen (includes item 13)(used on models 2P6H560, 2P7H560 etc)
	94299	#2 Pen (used on Models 2P2H560, 2P3H560 etc.)
15	85230	Indicator clamp
16	A2084	6-32 x 3/8" Pivot screw
17	95872	Indicator (#2 pen, blue)
20	95871	Indicator (#1 pen, red)
21	A2080	Indicator bracket (#1 pen)
22	45692	Washer
23	B1158	#1 Pen carriage (includes items 10, 11, 12 and 16)
24	B1161	#1 Pen (includes item 13)(used on models 2P6H560, 2P7H560 etc)
	94298	#1 Pen (used on Models 2P2H560, 2P3H560, etc.)
25	93390	Indicator guide
30	18339	6-40 x 3/16" Fillister-head screw
31	85291	Pulley shaft for 3-, 7-, 12- and 24-second pen speeds
	A2206	Pulley shaft for 1-second pen speed
32	64029	8-32 x 7/16" Fillister-head screw
33	92392	Cord-pulley bracket complete, left hand, for 3-, 7-, 12- and 24-second pen speeds (including items 31, 34, 35 and 36)
	98007	Pulley bracket only
	*82403	6-40 x 1/8" Flat-point setscrew
	A3814	Cord-pulley bracket complete, left hand for 1-second pen speed (including items 31, 34 and 35)
	98007	Pulley bracket only
	*82403	6-40 x 1/8" Flat-point setscrew
34	28211	Spacer
35	92390	Pulley for 3-, 7-, 12- and 24-second pen speeds
	A3811	Pulley for 1-second pen speed
36	79854	Retaining ring
37	B1157	Left-hand support bracket
38	66539	10-32 x 3/8" Fillister-head screw
39	85256	Pen guide rod
40	93380	Pen support rod #2 pen
41	85271	Pen support rod #1 pen
42	A1567	Bumper
43	47622	Washer
44	B1156	Right-hand support bracket
45	92387	Cord-pulley bracket complete, right hand, for 24- 12- 7- and 3-second pen speeds (including items 31, 34, 35 and 36)
	98006	Pulley bracket only
	*82403	6-40 x 1/8" Flat-point setscrew
	A3813	Cord-pulley bracket complete, right hand for 1-second pen speed (including items 31, 34 and 35)
	98006	Pulley bracket only
	*82403	6-40 x 1/8" Flat-point setscrew
46	A1568	Adjusting screw
47	A2067	Bumper bracket
48	76302	Spacer
49	85268	Bearing
50	85269	Locknut
51	39770	6-40 x 1/4" Fillister-head screw
52	91089	6-40 x 1/4" Special-head screw
53	93392	Post
54	61682	Double-headed screw
55		Scale (order by model and serial number of instrument)
56	20903	6-40 Hexagon nut

*Not Shown

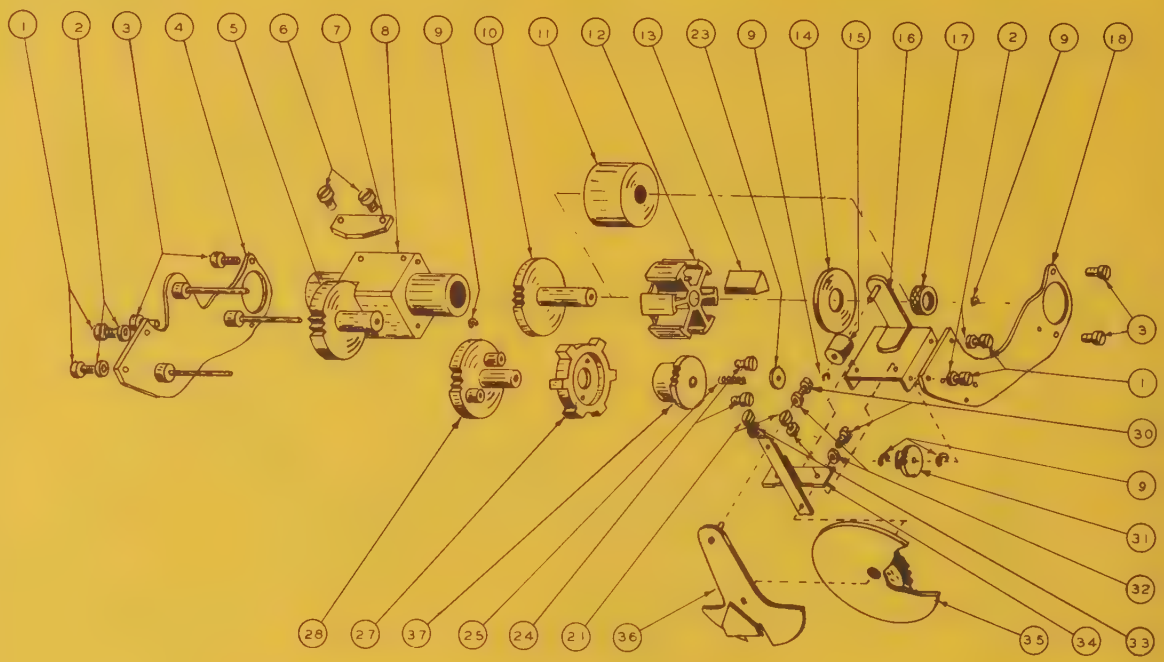


FIGURE 16. MULTIPLE-PRINTING MECHANISM

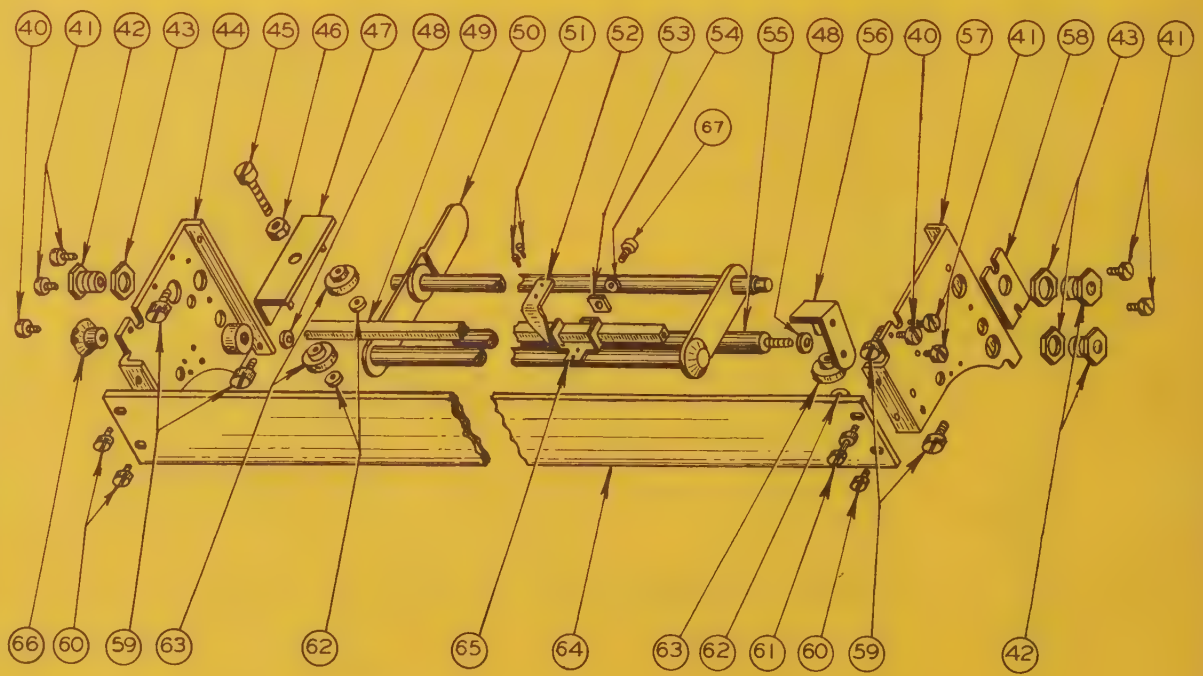


FIGURE 17. PRINTING MECHANISM SUPPORT FOR MULTIPLE-POINT RECORDER

ITEM	PART NO.	DESCRIPTION
1	37603	2-64 x 3/16" Fillister-head screw
2	68791	#2 Lockwasher
3	10626	4-48 x 1/8" Fillister-head screw
4	85263	Left-hand plate
5	86072	Gear (48T-48P)
6	30628	4-48 x 3/16" Fillister-head screw
7	85228	Cord clamp
8	85235	Frame
9	80607	Retaining ring (1/8" shaft)
10	88197	Gear (48T-48P)
11	89897	Ink roll complete for 1-color printing (purple)
	94449	Container of 5-rolls of item 11
12	68196	Felt-holder (6-segment)
	69626	Felt-holder (8-segment)
	94272	Felt-holder (12-segment) (Separate cap - part 94274)
13		INKING FELTS (CONTAINER OF 6)

	BLACK	RED	PURPLE	GREEN	BLUE	BROWN
6-segment	91000	91001	91002	91003	91004	91005
8-segment	91006	91007	91008	91009		
12-segment	94282	94283	94284	94400	94401	94402

14 DESIGNATION DISK

69545 - 2-point		69645 - 4-point	
68199 - 3-point		68198 - 6-point	

ITEM	PART NO.	DESCRIPTION
15	86070	Roller Complete
16	85293	Roller bracket complete
17	68182	Thumb nut
18	96762	Right-hand plate
21	65071	3-56 x 1/8" Fillister-head screw
23	23212	Washer
24	73927	2-64 x 7/32" Fillister-head screw
25	86066	Spring
27	87374	Type wheel (dots only) 2, 3, or 6-point
	87375	Type wheel (dots only) 4-point
		TYPE WHEEL (DOTS AND NUMBERS)

68193 - 2-point	68195 - 6-point	87841 - 12-point	96118 - 24-point
68194 - 3-point	69636 - 8-point	89872 - 16-point	
69637 - 4-point	94433 - 10-point	94440 - 20-point	

ITEM	PART NO.	DESCRIPTION
28	86073	Gear and hub (48P-48T)
30	63800	1-72 Fillister-head screw
31	96760	Idler gear
32	42762	Washer
33	96752	Washer
	70694	Shakeproof washer
34	96758	Mounting bracket
35		Indexing disc

96798 - 2-point	96788 - 6-point	96779 - 12-point	96770 - 24-point
96794 - 3-point	96785 - 8-point	96776 - 16-point	
96791 - 4-point	96782 - 10-point	96773 - 20-point	

ITEM	PART NO.	DESCRIPTION
36	96768	Shield and pointer
37	96753	Idler drive gear
	82403	6-40 x 1/8" flat-point setscrew
40	39770	6-40 x 1/4" Fillister-head screw
41	18339	6-40 x 3/16" Fillister-head screw
42	85268	Bearing screw
43	85269	7/16"-27 Hexagon nut
44	85298	Left-hand support bracket
45	66546	10-32 x 1" Fillister-head screw
46	72055	10-32 Hexagon nut
47	88185	Control-index pulley complete (including items 62 & 63)
48	86048	Thrust washer
49	88188	Control-index support rod
50	86088	Depressor bar
51	62795	2-64 x 3/32" Hexagon-head screw
52	88189	Control index
53	88191	Cord clamp
54	76293	2-64 Thumb nut
55	86078	Spline shaft
56	88181	Control-index pulley complete (includes items 62 and 63)
57	85249	Right-hand support bracket
58	86091	Adjusting plate
59	66539	10-32 x 3/8" Fillister-head screw
60	91089	6-40 x 1/4" Special-head screw
61	61682	6-40 Double-headed screw
62	79854	Retaining ring (3/16" shaft)
63	76283	Pulley
64		Scale (order by model and serial number of instrument)
65	88190	Control-index bracket
66	44009	Miter gear
67	40018	2-64 x 1/4" Fillister-head screw

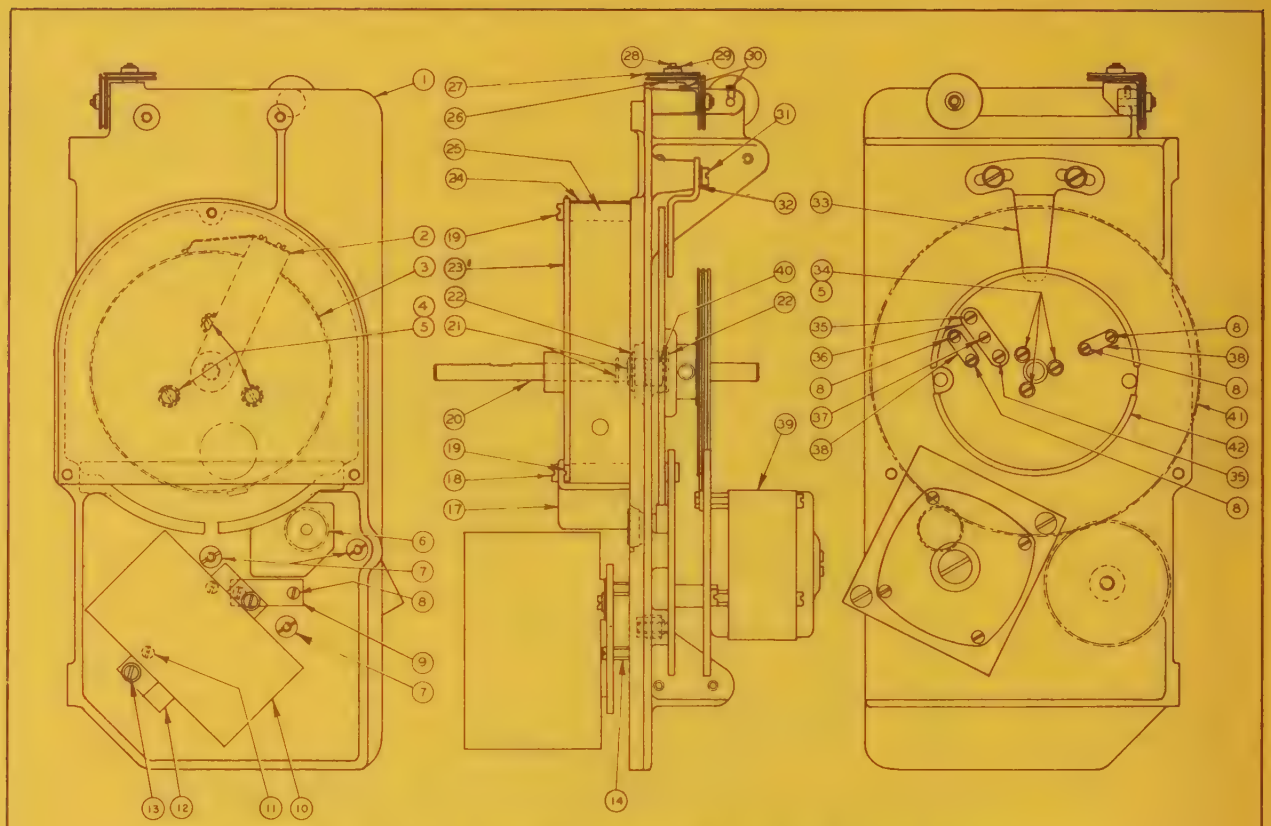


FIGURE 18. NO. 2 BALANCING MECHANISM FOR 2-PEN RECORDER

ITEM	PART NO.	DESCRIPTION
1	D1007	Frame
2	95638	Brush arm complete for a-c instruments
	95639	Brush arm complete for d-c instruments
	11394	3-56 x 1/4" Flat-head screw
	18371	3-56 x 3/16" Fillister-head screw
	89100	Support arm complete
	B1664	Contact arm
	95647	3-56 Shoulder screw
	95624	Mounting block
	95637	Clamping strap
	*82413	10-32 x 3/16" Flat-point setscrew for item 2
3		Slidewire (order by model and serial number of instrument)
5	43040	#6 Lockwasher
6		Motor pinion
	91930	For instruments with 24-second pen travel
	86036	For instruments with 7-second or 4.5-second pen travel
	91932	For instruments with 3-second or 1-second pen travel
	A2246	For instruments with 0.4-second pen travel
7	86053	Motor-mounting nuts
8	39770	6-40 x 1/4" Fillister-head screw
9	89118	Cable strap
10	B2767	Reference voltage source (Zener
11	20335	6-40 x 5/16" Flat-head screw
12	A7046	Mounting plate
13	A6254	8-32 x 1/4" Fillister-head screw
14	49767	Post
15	93658	Index
16	68345	6-40 x 3/16" Special-head screw
17	A2065	Cover
18	40066	8-32 x 1/4" Fillister-head screw
19	65984	10-32 x 1 1/2" Fillister-head screw
20	93034	Shaft
21	89117	Shaft retaining ring
22	24804	Thrust washer
23	A2063	Slidewire back cover

*Not Shown

(continued on page 19)

ITEM	PART NO.	DESCRIPTION
24	89865	Slidewire cover
25	89112	Post for slidewire cover
26	28211	Washer
27	92390	Pulley for instruments with 3-, 4.5-, 7- and 24-second pen travel
	A3811	Pulley for instruments with 0.4- and 1-second pen travel
28	85291	Pully shaft
29	80607	Retaining ring
30	82403	6-40 x 1/8" Flat-point setscrew
31	67029	10-32 x 5/16" Fillister-head screw
32	10075	Washer
33	85272	Gear stop for instruments with 3-, 4.5-, 7- and 24-second pen travel
	93320	Gear stop for instruments with 0.4 and 1-second pen travel
34	31427	6-40 x 5/16" Fillister-head screw
35	20021	6-40 x 1/4" Flat-head screw
36	76276	Tension-shaft clamp
37	76273	Tension shaft
38	85319	Cord clamp
39		Balancing motor
	96871	0.4-second pen speed motor (120 volt, 50-60 cycle)
	96873	1-second pen speed motor and gear train complete
	96871	1000 rpm motor (120 volt, 50-60 cycle)
	97640	Pinion (26T-64P) order with 6-40 x 1/8"flat-point setscrew No. 82403
	97638	Gear complete (72T-64P)
	96848	3-second pen speed motor and gear train complete
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96868	Gear complete (88T-64P)
	96849	4.5-second pen speed motor with pinion (120 volt, 60 cycle)
	96600	1100 rpm motor with pinion (120 volt, 60 cycle)
	96859	Gear complete (140T-64P)
	93699	7-second pen speed motor (120 volt, 60 cycle)
	96874	24-second pen speed motor and gear train complete
	96872	1000 rpm motor (120 volt, 60 cycle)
	97652	Gear complete (88T-64P, 15T-48P)
	97647	Gear complete (120T-48P)
40	86043	Needle bearing
41	A2102	Bull gear complete for 3-, 4.5-, 7- and 24-second pen travel (includes setscrew and items 5, 8, 34 thru 38 and 42)
	86052	Bull gear and hub only for 3-, 4.5-, 7- and 24-second pen travel
	B1556	Bull gear complete for 1- and 0.4-second pen travel (includes setscrew and items 5, 8, 34 thru 38 and 42)
	93360	Bull gear and hub only for 1- and 0.4-second pen travel
	89049	5/16-18 x 5/16" flat point setscrew
42	A2104	Sheave
	A3696	Drive cord #2 pen
		NOT SHOWN
		Power transformer for 2-pen ac-dc instrument mounted on front of hinged panel
	84245	Transformer (50-60 cycle, 120 volt prim., 8 volt sec.)
	72557	Transformer (25 cycle, 120 volt prim., 9 volt sec.)
	93672	Shield
	39770	6-40 x 1/4" Fillister-head screw

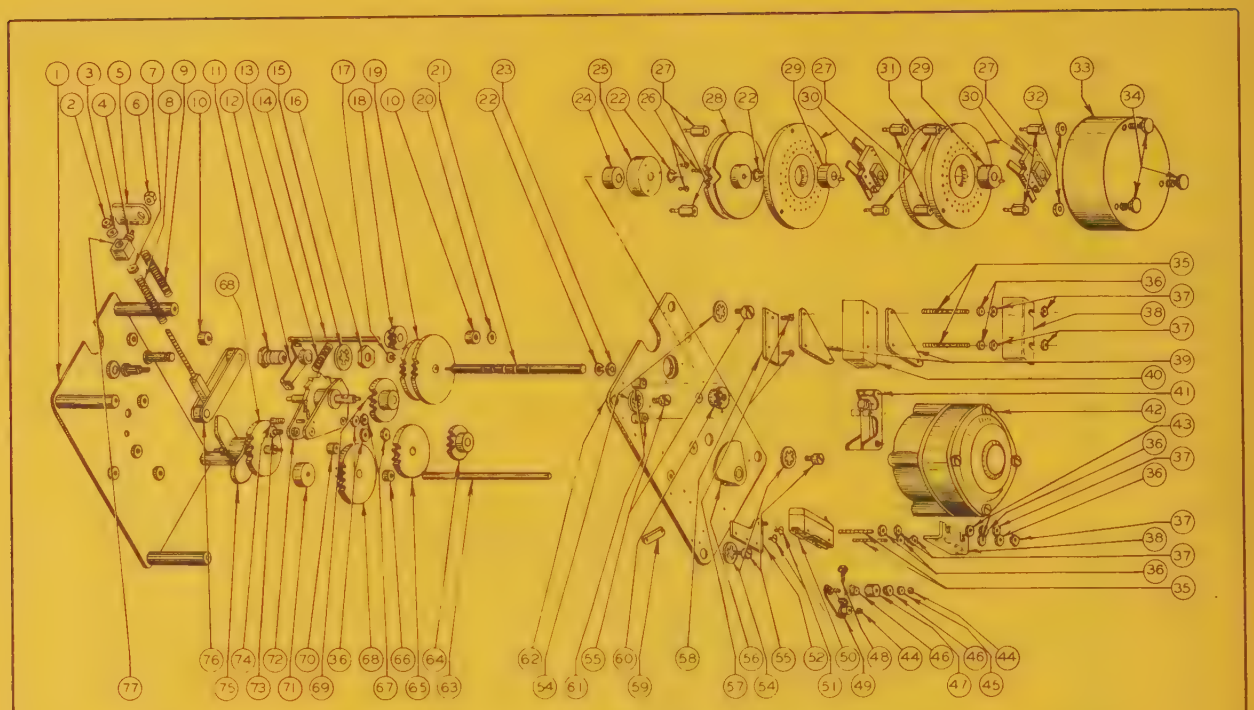


FIGURE 19. MULTIPLE-SWITCHING ASSEMBLY FOR MULTIPLE-POINT RECORDER

ITEM	PART NO.	DESCRIPTION
	C1516	Multiple switching mechanism for 0.4 sec. Dynamaster only.
	98068	Dynamaster multiple switching mechanism complete for all instruments except those with battery standardizing, less motor and switch deck. Specify model and serial number of instrument.
	98069	Dynamaster multiple switching mechanism complete for all instruments with battery standardizing, less motor and switching deck. Specify model and serial number of instrument.
1	88004	Front plate complete
2	82647	6-40 Self-locking nut
3	88083	Yoke washer
4	88081	Depressor yoke
5	86088	Depressor bar
6	89653	Depressor-yoke nut
7	88082	Spring collar
8	88080	Printing pressure spring
9	70610	Printing-lever spring
10	53889	Collar, including setscrew
	82403	6-40 x 1/8" Flat-point setscrew for item 10
11	95557	Latch-lever adjustment nut (see item 12)
12	95556	Latch-lever complete, includes items 11, 15, and 16
13	88032	Latch-lever spring
14	88092	Miter-gear shaft
15	40262	Lockwasher
16	40278	5/16"-32 x 1/8" Hexagon nut
17	79854	Tru-Arc retaining ring
18	88056	Pinion complete including setscrew
	82403	6-40 x 1/8" Flat-point setscrew for item 18
19		Gear including setscrew
	A5395	(50T x 84T - 48P) for 2-, 3-, or 6-point instrument
	A5396	(60T x 84T - 48P) for 4- or 8-point instrument
	A5397	(70T x 84T - 48P) for 10-point instrument
	A5398	(75T x 84T - 48P) for 12-point instrument
	A5399	(72T - 40P x 84T - 48P) for 16-point instrument
	A5400	(95T x 84T - 48P) for 20-point instrument
	A5401	(100T x 84T - 48P) for 24-point instrument
	82413	10-32 x 3/16" Flat-point setscrew for item 19
20	86048	Thrust washer
21	88084	Multiple-switching shaft for 560 Dynamaster
	96842	Multiple-switching shaft for Dynamaster Recorder deep case only.
22	91015	Retaining ring
23	61381	Thrust washer
24	88085	Ball bearing
25	88086	Bearing housing

ITEM	PART NO.	DESCRIPTION
26	89037	4-48 x 3/8" Flat-head screw
27	88068	Post 7/16" long, not including threaded end
	89375	Post 9/16" long, not including threaded end
	88070	Post 5/8" long, not including threaded end
	88144	Post 1 5/32" long, not including threaded end
28	89000	Gear (120T-48P) and cam assembly
29	96132	Switch-blade collar
30	98011	Switch plate and contact arm for 2-3-4-6-8-12-24 point multiple
	98013	Contact arm only for above
	98014	Switch plate and contact arm for 10 & 20 pt. multiple
	98016	Contact arm only for 10 & 20 pt. multiple
	98017	Switch plate and contact arm for 16 pt. multiple
	98019	Contact arm only for 16 pt. multiple
31	88067	Separating plate
32	82381	Washer
33	88071	Switch cover for a-c Bridge type instruments
	88145	Switch cover for d-c Potentiometer type instruments
34	55785	10-32 x 3/8" Thumb screw
35	86086	Switch stud
36	79008	#6 Lockwasher
37	20903	#6-40 Hex. nut
38	89863	Switch cover
39	79634	Cam-follower plate
40	54866	Snap-action switch
41	79622	Cam follower complete
	*79621	Spacer }
	*88173	Cam-follower shaft } used with item 41
	*80607	Retaining ring }
42	88060	Motor, 120 volt, 50-60 cycle for 8-, 15-, or 30-second print interval
	76209	Motor, 120 volt, 25 cycle for 8-, 15-, 30- or 60-second print interval
	92128	Motor, 120 volt, 50-60 cycle for 1.0-, 1.9-, 2.3-, 3.9- or 4.5-second print interval
	96738	Motor, 120 volt, 50-60 cycle for 60-second print interval
43	21252	Washer
44	80607	Retaining ring (see item 49)
45	15536	Washer (see item 49)
46	70903	Oil-less bushing (see item 49)
47	98044	Cam roller (see item 49)
	98043	Cam roller complete, includes items 46 and 47
48	79626	6-32 x 7/16" Hex-head screw (see item 49)
49	98040	Cam-follower arm complete, includes items 44, 45, 46, 47 and 48 (see item 52)
50	98035	Snap-acting switch
51	20335	6-40 x 5/16" Flat-head screw
52	98036	Cam follower complete (includes item 49)
54	35638	#10 Lockwasher
55	66537	10-32 x 1/4" Fillister-head screw
56	98070	Cam complete
57	21407	6-40 x 1/2" Flat-head screw
58	94890	Switch mounting plate
59	98053	Mounting strap
60	86018	Pinion (30T-48P) not including setscrew
	*82403	6-40 x 1/8" Flat-point setscrew for item 60
61	95911	Spacer
62	88001	Back plate complete
63	98072	Cam shaft
64		Motor pinion
	92129	(46T-48P) for 8-second print interval
	94261	(22T-48P) for 3.9- or 60-second print interval
	88061	(19T-48P) for 4.6- or 30-second print interval
	89150	(36T-48P) for 2.3- or 15-second print interval
	94460	(37T-48P) for 1.9-second print interval
	98000	(63T-48P) for 1.0-second print interval
	82413	10-32 x 3/16" Flat-point setscrew for item 64
65		Gear, including setscrew
	94263	(86T-48P) for 3.9- or 60 second print interval
	88014	(89T-48P) for 2.3- or 4.6-second print interval
	92131	(62T-48P) for 8-second print interval
	94462	(71T-48P) for 1.9-second print interval
	94464	(62T-48P) for 1.0-second print interval
	82413	10-32 x 3/16" Flat-point setscrew for item 65
66	53172	Collar, not including setscrew
	*82403	6-40 x 1/8" Flat-point setscrew
67	772	6-40 Hex. nut
68	94515	Gear complete (74T-48P)

*Not Shown

(continued on page 22)

(continued from page 21)

ITEM	PART NO.	DESCRIPTION
69		Ratchet-shaft gear
	88037	(100T-48P) for 2-, 3- or 6-point instrument
	88072	(90T-48P) for 4- or 8-point instrument
	94427	(84T-48P) for 10-point instrument
	86076	(75T-48P) for 12-point instrument
	89874	(54T-40P) for 16-point instrument
	94435	(57T-48P) for 20-point instrument
	96116	(50T-48P) for 24-point instrument
	82413	10-32 x 3/16" Flat-point setscrew for item 69
70	88034	Cam roll
71	98031	Ball bearing
72	98027	Ratchet assembly complete, includes items 36, 67, 70, 71, 73 and 74
73	98032	Shoulder screw
74	98093	Stud
75	98073	Cam shaft assembly complete
76	88042	Printing lever complete
77	95913	Sleeve

PRINT INTERVAL	MOTOR (ITEM 42 FIG. 19)		GEAR			
	50-60 CYCLE	25 CYCLE	ITEM NUMBER	PITCH	NUMBER OF TEETH	PART NUMBER
1.0 sec.	92128	.....	64 65	48 48	63 62	98000 94464
1.9 sec.	92128	.....	64 65	48 48	37 71	94460 94462
2.3 sec.	92128	.....	64 65	48 48	36 89	89150 88014
3.9 sec.	92128	.....	64 65	48 48	22 86	94261 94263
4.5 sec.	92128	.....	64 65	48 48	19 89	88061 88014
8 sec.	88060	76209	64 65	48 48	46 62	92129 92131
15 sec.	88060	76209	64 65	48 48	36 89	89150 88014
30 sec.	88060	76209	64 65	48 48	19 89	88061 88014
60 sec.	96738	76209	64 65	48 48	22 86	94261 94263

FIGURE 20. TABLE OF MOTORS AND CHANGE GEARS FOR MULTIPLE-SWITCHING ASSEMBLY

LOW SPEED GEAR TRAIN 120 V. 60 Cycle				HIGH SPEED GEAR TRAIN 120 V. 60 Cycle			Gear Position	Pitch	Number of Teeth	Part Number	Identification
2 RPM TELECHRON 86058	4 RPM TELECHRON 92110	10 RPM HOLTZER CABOT 88060	60 RPM HOLTZER CABOT 53680	4 RPM HOLTZER CABOT 96738	10 RPM HOLTZER CABOT 88060	60 RPM HOLTZER CABOT 92128					
Chart Speed (inches/hour)			Chart Speed (inches/min.)			Chart Speed (inches/sec.)					
3/4	1 1/2	3 3/4	3/8	1	2 1/2	1/4	1 2	40 40	16 64	92105 92103	C H
1	2	5	1/2	1 1/3	3 1/3	1/3	1 2	48 48	24 72	79225 79223	J N
1 1/2	3	7 1/2	3/4	2	5	1/2	1 2	48 48	32 64	79218 79222	K M
2	4	10	1	2 2/3	6 2/3	2/3	1 2	40 40	32 48	79227 79221	E F
3	6	15	1 1/2	4	10	1	1 2	48 48	48 48	79224 79224	L L
4 1/2	9	22 1/2	2 1/4	6	15	1 1/2	1 2	40 40	48 32	79221 79227	F E
5	10	25	2 1/2	6 2/3	16 2/3	1 2/3	1 2	40 40	50 30	94210 94212	G D
6	12	30	3	8	20	2	1 2	48 48	64 32	79222 79218	M K
9	18	45	4 1/2	12	30	3	1 2	48 48	72 24	79223 79225	N J
10	20	50	5	13 1/3	33 1/3	3 1/3	1 2	32 32	50 15	94214 94216	B A
12	24	60	6	16	40	4	1 2	40 40	64 16	92103 92105	H C

FIGURE 21. TABLE OF MOTORS AND CHANGE GEARS FOR SINGLE-SPEED CHART DRIVE

FAST SPEED GEAR TRAIN					CHANGE GEARS	
MOTOR SPEEDS (120 V. 60 Cy. only)					NUMBER OF TEETH	PART NUMBER
1 RPM	2 RPM	4 RPM	10 RPM	60 RPM		
B1277	B1276	96738 55327 (a)	88060	B1279 53680(a)		
CHART SPEED (inches per minute)				CHART SPEED (inches per second)		
1/4	1/2	1	2-1/2	1/4 (a)	16 64	A2531 A2529
1/3	2/3	1-1/3	3-1/3	1/3 (a)	24 72	A1539 A1536
1/2	1	2	5	1/2 (a)	32 64	A1540 A1544
2/3	1-1/3	2-2/3	6-2/3	2/3 (a)	32 48	A2527 A2526
1	2	4	10	1 (a)	48 48	A1542 A1542
1-1/2	3	6	15	1-1/2 (b)	48 32	A2526 A2527
2	4	8	20	2 (b)	64 32	A1544 A1540
3	6	12	30	3 (b)	72 24	A1536 A1539
4	8	16	40	4 (b)	64 16	A2529 A2531

(a) Used for two-pen Dynamasters, and with only the five speeds indicated.
(b) May run 1% slow.

FIGURE 22. CHART SPEEDS & CHANGE GEARS FOR WIDE-STRIP DYNAMASTERS WITH 2-SPEED ATTACHMENT T84. MOTORS ARE HOLTZER-CABOT 120V 60 CYCLE.

BE SURE TO STATE MODEL AND SERIAL NUMBERS OF INSTRUMENT WHEN ORDERING PARTS

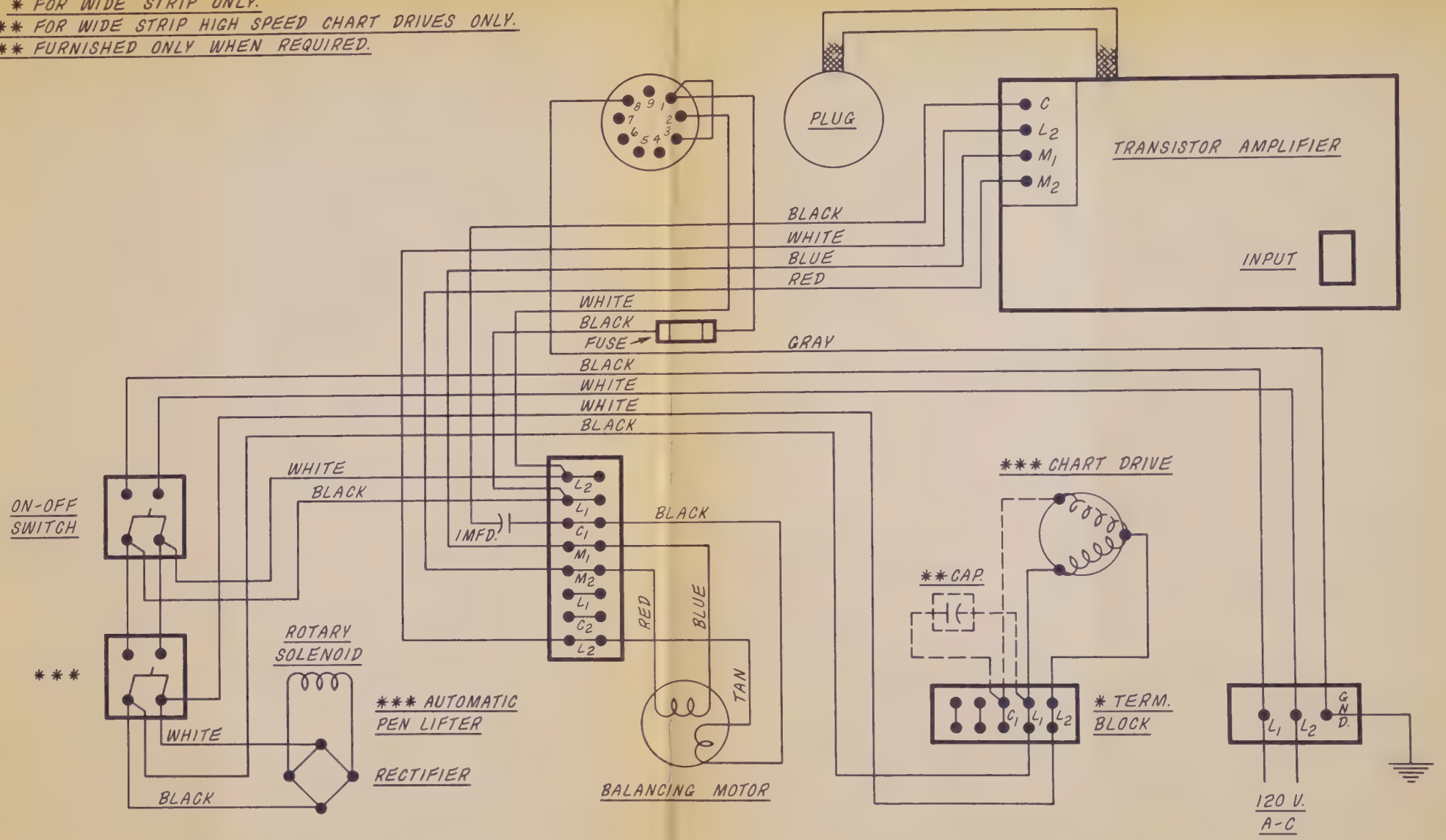
NOT SHOWN ITEMS

PART NO.	DESCRIPTION
	AUTOMATIC STANDARDIZATION TIMER:
91945	Timer, including motor, bracket, switch etc., (120 volt, 50-60 cycle)
95693	Timer, including motor, bracket, switch etc., (120 volt, 25 cycle)
18339	6-40 x 3/16" Fillister-head screw for mounting timer
89127	Switch for timer
	CONSTANT VOLTAGE UNIT
91936	Constant voltage unit complete (No Batt®) 60 cycle
91937	Chassis
91938	Power transformer
91941	Relay
96177	Resistance spool (1000 ohms manganin)
96176	Resistance spool (800 ohms nickel ±5%)
91942	Rectifier
91943	Capacitor (100 mfd, 12 volts d-c)
96178	Resistance spool (2500 ohms manganin)
96175	Isolation transformer
96171	Capacitor (0.22 mfd, 850 volts a-c)
96172	Capacitor (0.235 mfd, 850 volts a-c)
96173	Capacitor (0.25 mfd, 850 volts a-c)
96174	Capacitor (0.295 mfd, 850 volts a-c)
	(as required)
C1669	Constant voltage unit complete (50 cycle)
	POWER PACK
92976	Power pack for d-c resistance recorder
92975	Chassis
76324	Transformer
91942	Rectifier
92977	Condenser
79357	Choke
93305	Resistor
90636	Cover
	AUTOMATIC PEN LIFTER (Attachment T6)
93336	Rotary solenoid
82096	Spring
93347	Rectifier
	PEN ACCESSORIES
A8253	Ball point pen (Red)
A8254	Ball point pen (Blue)
A8255	Ball point pen (Green)
A8256	Ball point pen (Black)
	(Screw in Type)
A6500	2-ounce bottle of red ink
A6502	2-ounce bottle of blue ink
A6526	2-ounce bottle of black ink (reproducible)
72693	Pen filler
A3801	Pen starter
32900	Pen cleaner
	MISCELLANEOUS PARTS
98130	1/4-ounce bottle of Cramolin
A5700	1-pint Bristol cleaning fluid (metal container)
91982	Bristol Motor Oil (plastic container)
89030	Drive cord
	EXTRA PARTS FOR 25 CYCLE INSTRUMENTS
	CAPACITOR (mounting of right under amplifier shelf)
74480	Capacitor (0.5 mfd, 600 volts d-c)
82656	6-32 x 3/16" Binding-head screw
	OUTPUT TRANSFORMER (on back of case)
92736	Output transformer
64029	8-32 x 7/16" Fillister-head screw
72166	Spacer for screw, part #64029
	RESISTOR (mounted on back of panel of d-c instrument)
93961	Resistor (150 ohm, 25 watt)
45078	Washer (brass)
35218	Washer (insulating)
65876	6-40 x 2 1/4" Fillister-head screw

The Bristol Company
Waterbury 20, Connecticut

Printed In U.S.A.

* FOR WIDE STRIP ONLY.
** FOR WIDE STRIP HIGH SPEED CHART DRIVES ONLY.
*** FURNISHED ONLY WHEN REQUIRED.

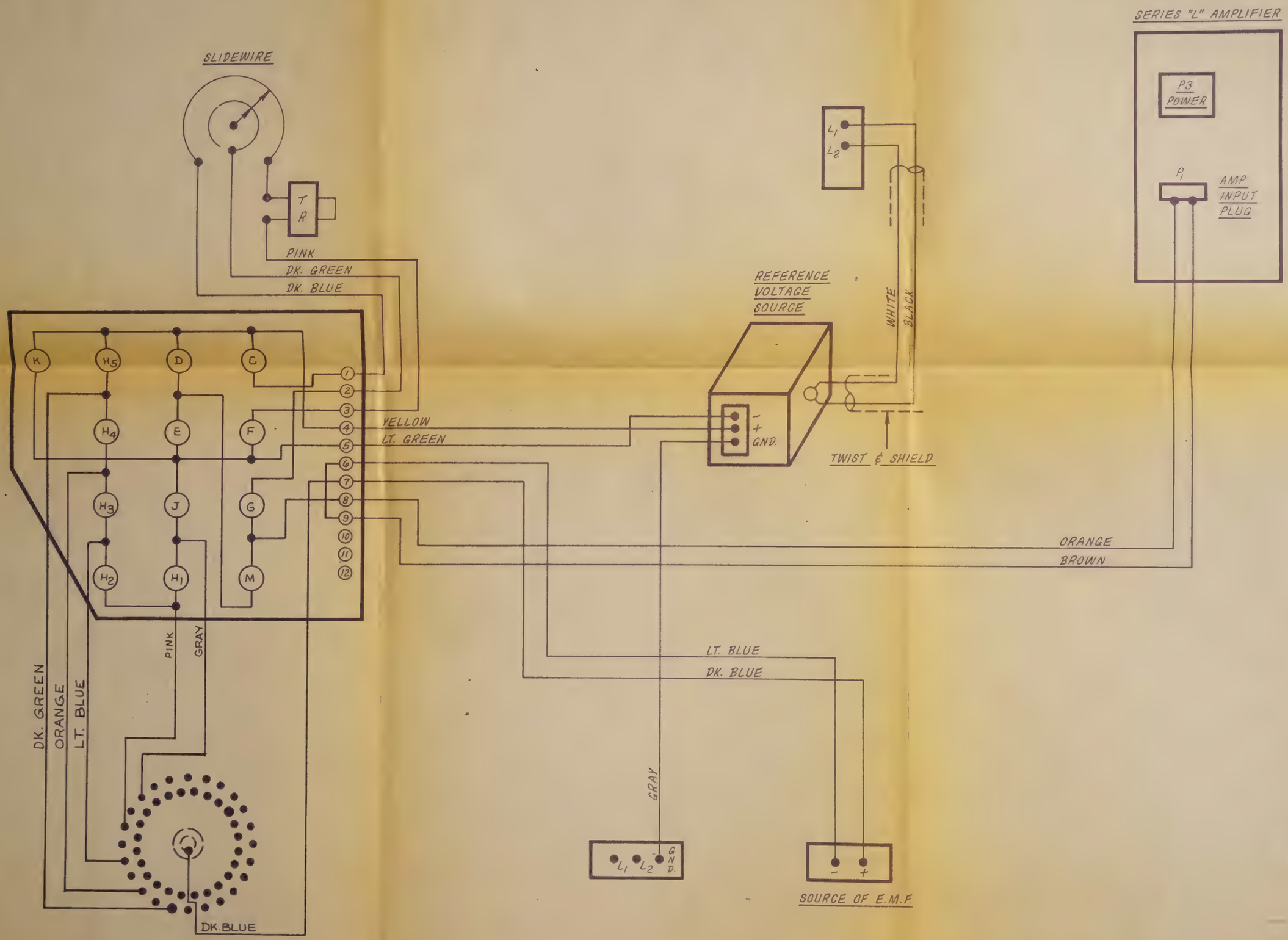


POWER CIRCUIT WIRING DIAGRAM
FOR SINGLE-POINT WIDE STRIP OR ROUND CHART D-C DYNAMASTER POTENTIOMETER, FOR USE WITH TRANSISTOR AMPLIFIER.

REVISIONS		
		6-11-64

THE BRISTOL COMPANY
WATERBURY, CONN. U.S.A.

DRAWN B.F.H.	DATE 4-24-64	
TRACED	CHECKED CDN	APPROVED
SCALE	FILE DR. 122	
NO. 020567		



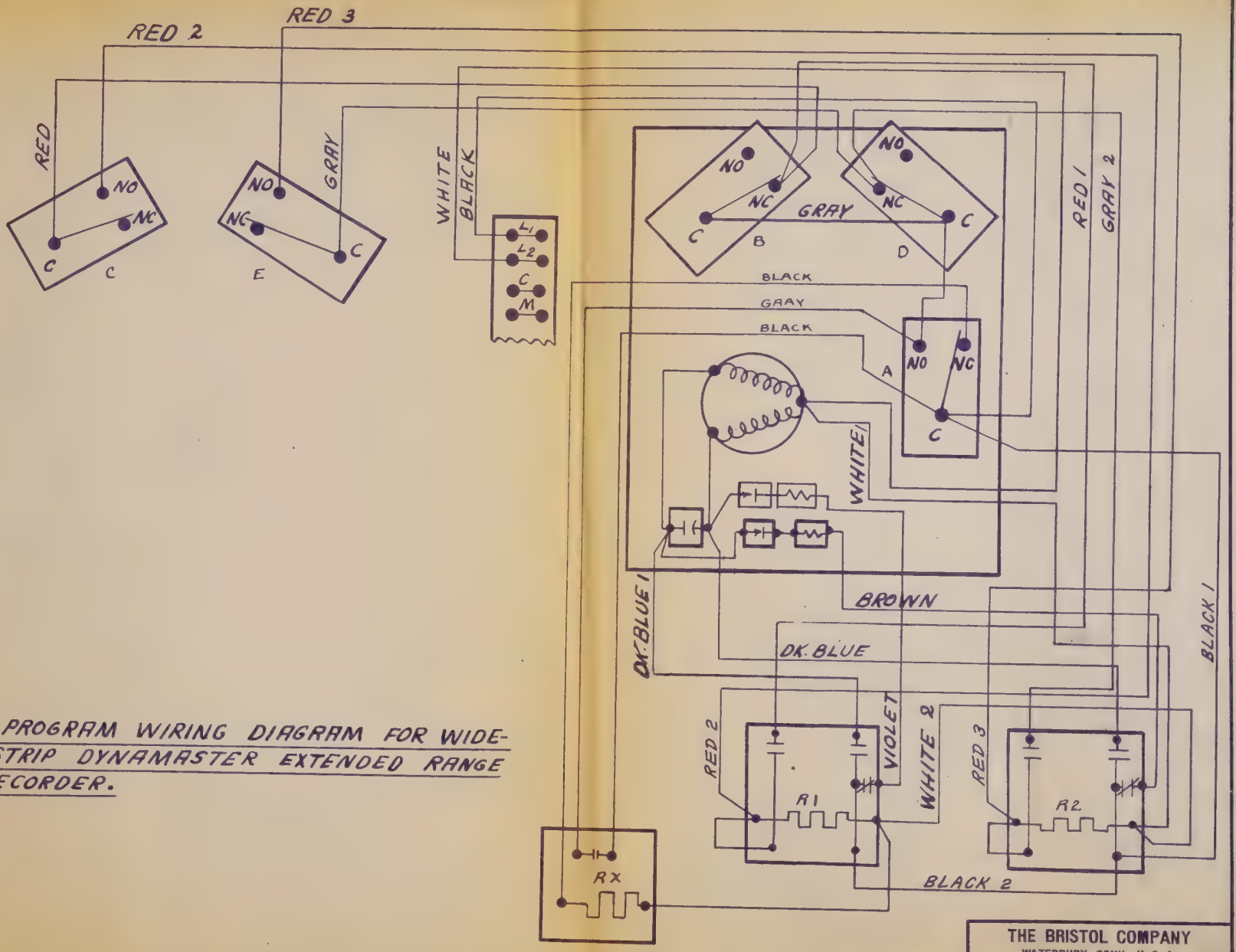
REVISION	(A) 4174				
DATES	2-19-68				

H-E

MEASURING CIRCUIT WIRING DIAGRAM FOR
FIVE RANGE EXTENDED RANGE
RECORDER.

THE BRISTOL COMPANY
WATERBURY, CONN., U. S. A.

DRAWN R.A.F. APPROVED TRACED
CHECKED JWK DATE 4-14-65 SCALE
DRAWER No. 221
SHEET No. 021708-5



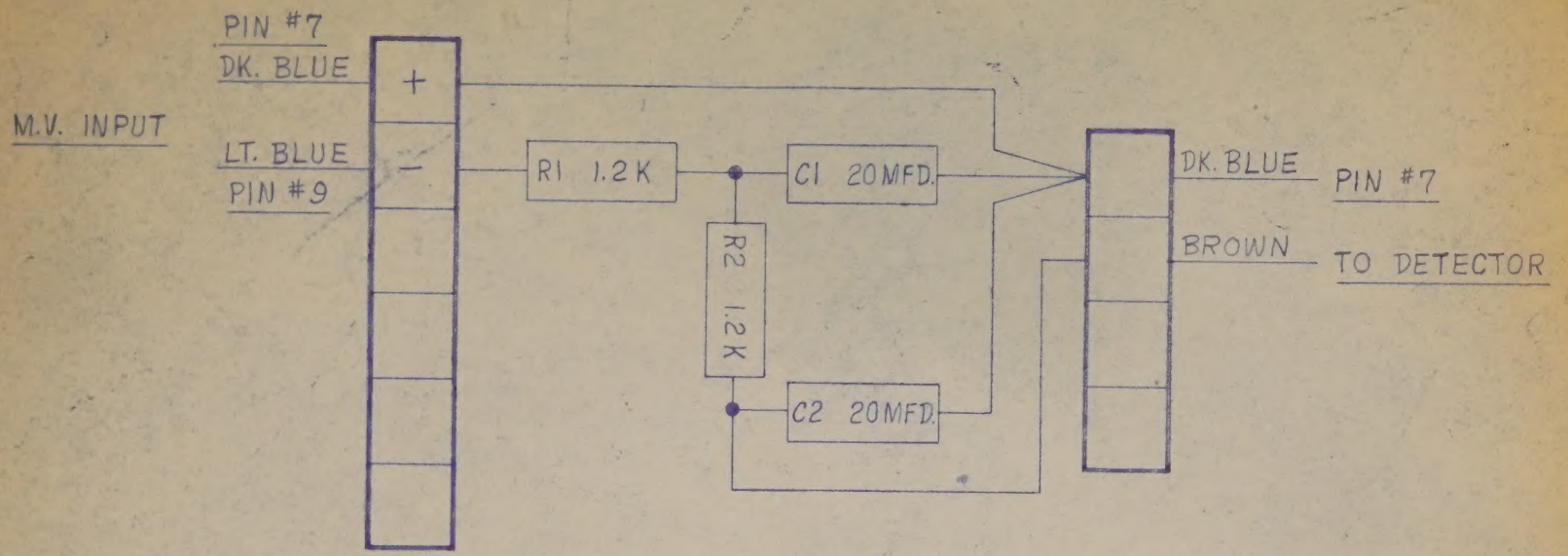
PROGRAM WIRING DIAGRAM FOR WIDE-STRIP DYNAMASTER EXTENDED RANGE RECORDER.

B. CO. ORDER NO. | CUSTOMER ORDER NO. | SERIAL NO.

		11·20·61	REVISION DATES
		2·12·62	8·7·59

THE BRISTOL COMPANY
WATERBURY, CONN., U. S. A.
DRAWN M.E.K. TRACED
DATE 4-3-59 DRAWER NO. 122
SHEET NO. 017363

DEFIANCE NO. 93 35256



REMOVE BROWN WIRE FROM TERMINAL #9 & SPLICE WITH BROWN WIRE FROM FILTER.

NO. 022619

FILTER FOR USE WITH TRANSISTOR AMPLIFIER.

DRAWN B.F.H.	DATE 7-12-66
TRACED	CHECKED J.J.J. / APPROVED J.J.J.
SCALE	FILE DR. 21
NO. 022619	

REVISIONS

THE BRISTOL COMPANY
WATERBURY, CONN. U.S.A.

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INDUSTRIAL SUPPLIES & MACHINERY GROUP

American Welded & Weldless Chain and Attachments, ACCO Registered & Kuplex Sling Chains, Allison Abrasive Cut-Off and Grinding Wheels; Campbell Abrasive Cut-Off Machines; Hydraulic Presses, Nibbling Machines, Punches, Dies; Victor Masonry Cutting Saws and Blades; Malleable Iron Castings; Bristol Socket Screws; Maryland Bolts and Nuts; Weed Tire Chains

WIRE PRODUCTS GROUP

American Cable & Hazard Wire Rope, Wire Rope, Nylon, Dacron & Woven Wire Slings; Page Welding Wire; Strand; Manufacturers Wire; Aluminized Chain Link Fence; Tru-Lay Push-Pull Remote Controls; Automotive and Aircraft Cable Assemblies; Terminals; Tow Lines; SteerMaster Marine Steering Equipment; Clutch and Throttle Controls; Korodless Yacht Rigging

MATERIAL HANDLING GROUP

Mechanical Handling Systems, Automotive Power and Free, Tow Line, and Sortation Systems; Floor Lines and Overhead Trolley Conveyors; Driverless Tractors; Work Carriers and Storage Racks; Louden Monorail Cranes and Systems; Wright Hoists and Cranes; Mansaver Grabs and Custom Engineered Hook Attachments; ACCO Chain, Wire Rope, Nylon, Dacron, and Woven Wire Slings, ACCO Custom Engineered Material Handling Equipment, Wire Rope and Cable Winches

INSTRUMENTS & ELECTRONICS GROUP

Bristol Automatic Controlling, Recording, Electronic and Telemetering Instruments; Syncroverter Choppers; Data-Master Digital and Computing Data Loggers; Solid State Supervisory Control Systems; High Speed Serial-Entry Printers; Electro-Mech Centralized Control and Annunciator Systems; ACCO Gyros, Accelerometers, and other Inertial Equipment; Helicoid Pressure Gages; Wilson "Rockwell" Hardness Testers

INTERNATIONAL GROUP

In Canada
DOMINION CHAIN COMPANY Limited, Stratford, Ontario
CANADIAN WARREN PINK division of Dominion Chain Company Limited
St. Catharines, Ontario and Vancouver, British Columbia
THE BRISTOL COMPANY OF CANADA Limited, Toronto, Ontario
CANADIAN MECHANICAL HANDLING SYSTEMS LTD., Windsor, Ontario

In England
MHS INTERNATIONAL, Inc., Watford, Herts
PARSONS CHAIN COMPANY Limited
BRITISH WIRE PRODUCTS Limited, Stourport-on-Severn, Worcestershire

In Mexico
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